BASE COMPREHENSIVE PLANNING
TRANSPORTATION PLANNING BULLETIN

prepared for
United State Air Force
HQ USAF/LEEVX

by
JHK & ASSOCIATES

ACKNOWLEDGMENTS

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PREFACE

HOW TO USE THIS BULLETIN

The Transportation Planning Bulletin is one in a series of bulletins to support the Erase Comprehensive Planning (BCP) regulation (AFR 86-4, Ref. 15). The Bulletin serves as a source for transportation planning principles and methodologies. It also serves as a guide to base planners who are responsible for making short-term transportation improvements and for developing the transportation component of the BCP.

THE BULLETIN FOLLOWS EACH STEP OF THE PLANNING PROCESS. Depending on the status of the transportation plan on a particular base, the planner may start at the beginning or refer to specific sections of the bulletin as indicated in the diagram on page ii. A detailed Table of Contents serves as an index to individual topics.

Throughout the bulletin there are practical examples of transportation planning and principles applied to the specific needs on Air Force bases. Several examples are also shown on "Anytown" Air Force Base, which was developed for illustrative purposes in this bulletin. Appendix A contains a descriptive outline of a transportation plan for Anytown AFB. This outline should serve as the "core" of a statement of work for the Transportation Plan Component of the BCP.

Major commands are responsible for establishing transportation programs for their installations using the guidance in the Bulletin. Preparation of a Base Transportation Plan is required as part of the BCP.

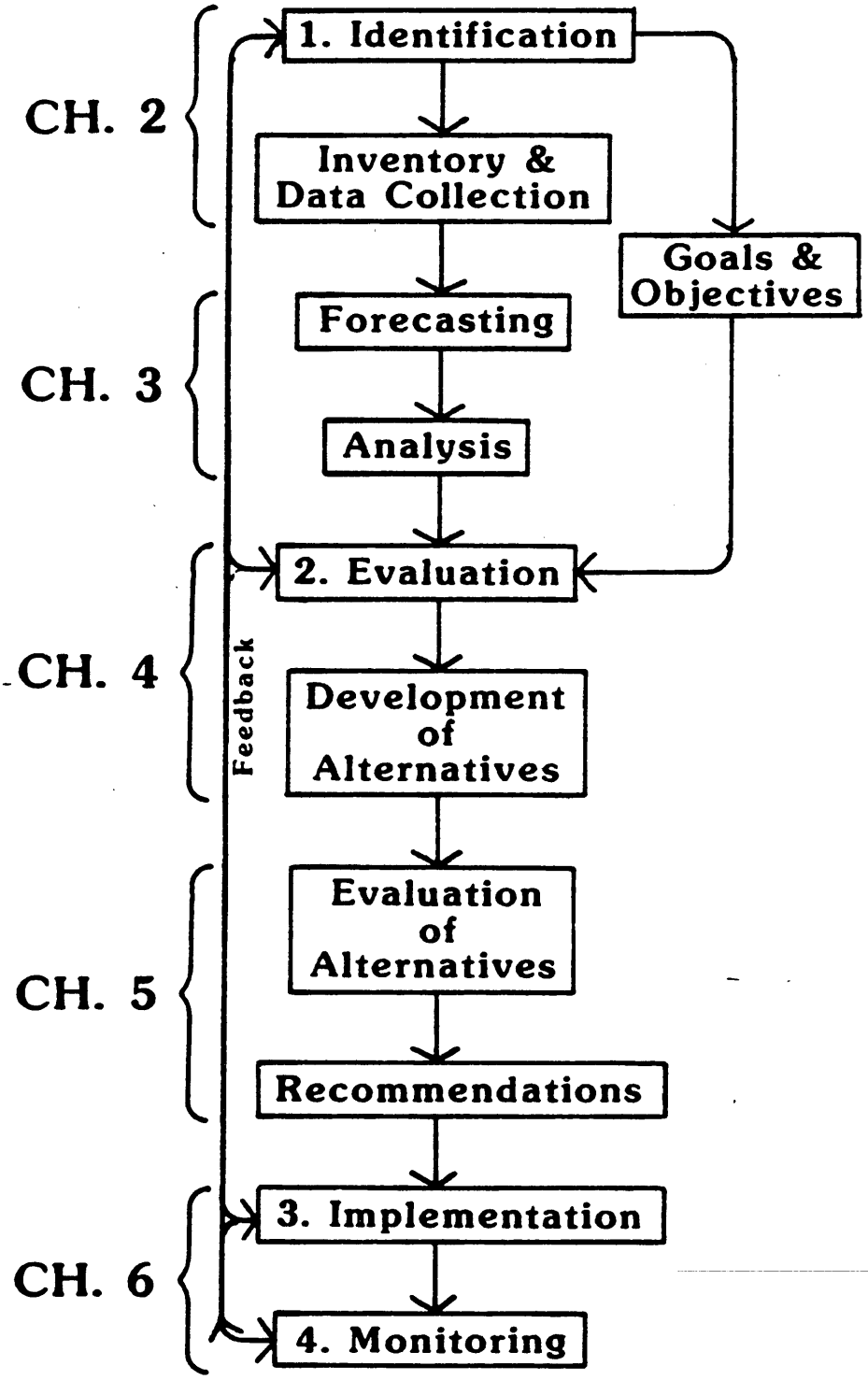
A GUIDE FOR DAILY AND FUTURE PLANNING ACTIVITIES

The planner can use the bulletin as a reference guide in several ways: Help with day-to-day activities -

Steps:

l. Read Chapter l
2. Examine Table 2-2 to determine inventory needs. Then read the. appropriate sections of Chapter 2.
3. Examine Table 3-1 to determine the forecasting and analysis needs for typical problems and opportunities. Then read the appropriate sections of Chapter 3.

Transportation Planning Process



4. Examine Figure 4-1 to identify appropriate transportation actions to consider. Read more about the actions throughout Chapter 4.
5. Read Chapters 5 and 6 to determine appropriate ways to evaluate and implement transportation improvements.

Produce a transportation plan using base personnel.

Steps:

1. Read Chapter 1
2. Read Appendix A - Sample Plan Outline
3. Read Chapters 2 through 6 in order to understand planning process.
4. Reread Chapters as needed during plan preparation. Use Table 2-2, Table 3-1, and Figure 4-1 to focus on specific topics in each Chapter.

Produce a transportation plan with assistance from the Military Traffic Management Command (MTMC).

Steps:

l. Read Chapter l
2. Read Appendix A - Sample Plan Outline
3. Read Chapters 2 and 3 to determine study goals/objectives, inventory needs, problems and opportunities, and necessary forecasting and analysis techniques. Assess capabilities of base personnel and decide appropriate role for MTMC to fill.
4. Review AFR 75-88 to forward requests to MTMC.
5. Read Chapters 4, 5, and 6 in enough detail to support MTMC planning assistance. As necessary, reread specific technical information in Chapters 2 and 3.

Produce a transportation plan with consultant assistance

Steps:

1. Read Chapter I
2. Read Appendix A - Sample Plan Outline
3. Read Chapters 2 and 3 to determine study goals/objectives, inventory - needs, problems and opportunities, and necessary

forecasting and analysis techniques. Assess capabilities of base personnel and decide appropriate role for consultant.

4. Read Chapters 4, 5, and 6 in enough detail to permit review of the Consultant products.

USE OF OUTSIDE ASSISTANCE

Many studies involving significant- inventory, forecasting, and analysis activities will require outside assistance form the Military Traffic Management Command (MTMC) or from private consultants. USE THIS BULLETIN TO ASSESS WHICH PORTIONS OF THE PLANNING PROCESS CAN BE ADEQUATELY PERFORMED ON BASE. At that point, make a knowledgeable decision as to the amount of outside services that would be required.

The MTMC can conduct transportation planning studies for Air Force installations. These studies can vary from base wide transportation planning to transportation planning of specific projects such as major roadways, intersections, gates, community centers and parking facilities. To obtain MTMC services, forward requests through command channels to HQ AFESC/DEM in accordance with instructions in AFR 75~8 (Ref. 13).

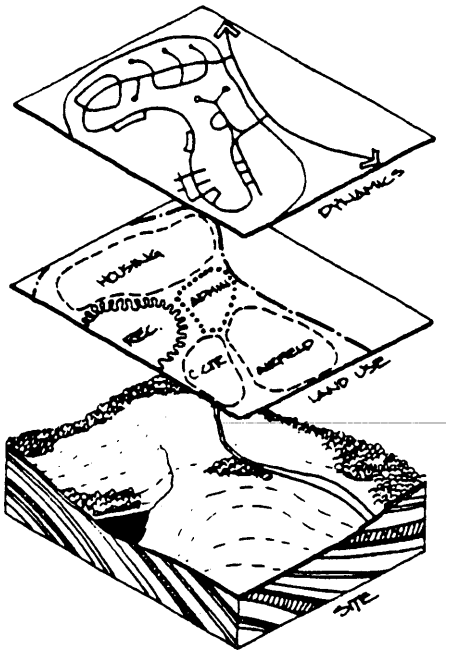
If MTMC resources will not enable the requested transportation planning assistance to be provided within the desired time, MTMC can assist the installation in developing a scope of work for contracting the study. MTMC also can provide technical reviews of the plans, studies and reports developed by contract or the base.

REFERENCES

Transportation planning is a new BCP topic which replaces the following portions of AFM 86-6 (Ref. 18) - Chapter 7, Access Roads Program; and the "Traffic Engineering Criteria's section of Attachment 5.

Appendix F contains references to several other military and civilian documents which complement the Transportation Planning Bulletin. These include other BCP bulletins, MTMC pamphlets, and Air Force Manuals. Relevant sources are cited throughout the remainder of this bulletin.

CHAPTER 1



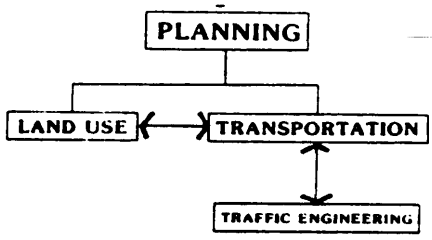
INTRODUCTION

TRANSPORTATION is essential to the mission of the Air Force and its bases. Transportation means people traveling to work, to school, to shop, and to many other activities on and off the base. Transportation also supports the economic activity and the mission of the base, because it includes moving services or goods to people who need them. This is especially crucial in times of emergency.

Transportation provides the DYNAMIC element of a system. Together with related systems of utilities and communications, transportation binds together the natural environment and land uses by moving persons and goods throughout the base.

WHAT IS TRANSPORTATION PLANNING?

PLANNING is the orderly process of anticipating obstacles in the path leading to a goal, then preparing to overcome those obstacles. TRANSPORTATION PLANNING is the process used to determine appropriate means to provide for the safe and efficient movement of people and goods. Transportation and land use planning are closely linked throughout this process, in that each of them serves and shapes the future land use development. Without a planning process, large expenditures may he made on transportation facilities or services without adequate knowledge of the need for them, their priority or their potential impacts on land uses.



Transportation planning is often discussed together with the term TRAFFIC ENGINEERING. Traffic engineering focuses on the engineering aspects of travel on the highway system. The distinction is important.

HOW IS TRANSPORTATION PLANNING USED?

Transportation planning improves both access and accessibility. ACCESS is the physical means of traveling between two points.

ACCESSIBILITY represents the degree of opportunity available to a person to gain access to a particular location. Through effective planning, adequate provisions can be made for access using a combination of civilian and military facilities.

Access Road Program

Civilian highway authorities have the responsibility to construct and maintain public highways that provide access to Air Force bases. However, the DEFENSE ACCESS ROAD PROGRAM was established as a means for the Department of Defense to pay its fair share for highway improvements necessitated by sudden and unusual defense-related impacts upon the public highway system. Sudden or unusual impacts are generally those defined as a sudden doubling of military traffic because of expanded base mission, opening a new gate, or replacement of public highways that have been closed for military operations or site expansion. In such cases the Commander, MTMC, has authority to certify roadways as being important to national defense and to authorize military construction funds necessary for the design and construction of such highways.

Installation officials have the responsibility to identify existing and potential public highway problems that affect the installation mission. Installation officials should present these problems to the local highway authorities to ensure that base needs are given appropriate consideration on the planning of improvements to public roadways in the regular highway program. If the local authorities cannot or will not correct the problems, a defense access road needs report should be prepared and forwarded through command channels to MTMC in accordance with Instructions provided in paragraph 2-12 of AFR 75-88 (Ref. 13).

Base Planning

On base, proper planning ensures that safe and efficient movements by almost any means of travel can occur among different land uses. For example, since a BX serves many different users, it is important to have an adequate street system leading directly to it, as well as adequate parking, pedestrian sidewalks, bicycle facilities, and bus stops. Planning can also assist in making the trip between the BX and an adjacent housing or employment area as direct, safe, and pleasant as possible

Good planning provides opportunities for people to gain appropriate access to on- and off-base land uses. This is a critical issue on many bases where people may not have cars or other means to reach off-base facilities. In such cases, planning assists by encouraging alternative modes of travel, such as public transit or carpooling. Figure 1-1 provides several on-base situations that require transportation planning assistance.

THE TRANSPORTATION PLANNING PROCESS

Transportation planning considers EXISTING and FUTURE time periods. Many base planning activities concentrate on the short term (up to five years). Planning for longer term periods (5 to 20 years) is also important in the BCP process. Land use and major transportation changes often require a long lead time before implementation. Therefore, it is essential that the transportation (and land use) plans jointly consider future needs, so that they can influence the development of the base, rather than merely react to it.

The transportation plan must be integrated with several other elements of the BCP, including the plans for land use, communications, environmental design, energy, and the socio-cultural environment. Because of these interactions, the planner should follow an established transportation planning process.

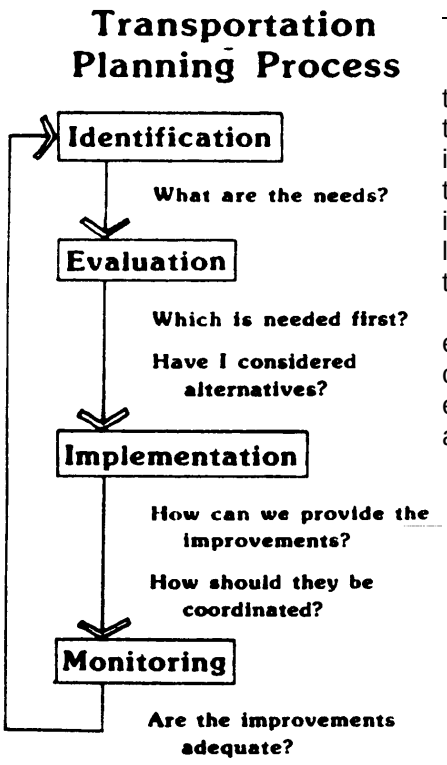
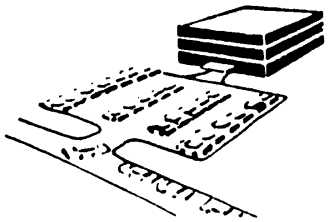
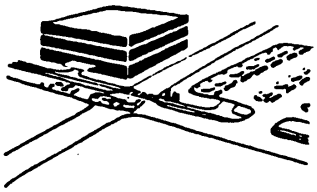


FIGURE 1-1.

TRANSPORTATION PLANNING CAN HELP THESE TYPICAL SITUATIONS

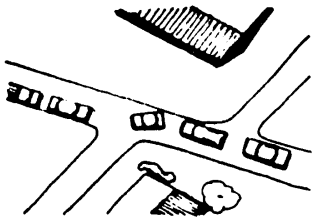
Inadequate parking at MAJCOM administrative building. Long walking distances for many employees

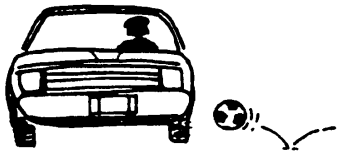




High vehicle and pedestrian accident rate at busy intersection. High pedestrian volumes cross from parking lot to employment sites

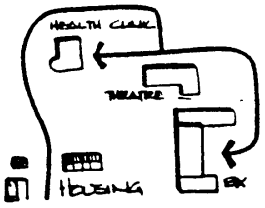
Congestion and frequent turning accidents on perimeter or major through road

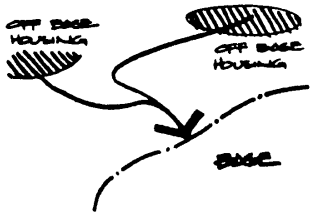




High volumes, speeds, and pedestrian accidents in housing areas

Circuitous travel required from housing area to scattered community services





Heavy concentration of base employees live off-base in specific communities

Effective Transportation Planning

- **Anticipates future movement needs.**
- **Requires cooperation among commands and outside agencies.**
- **Is continuous.**
- **Is comprehensive in the consideration of land uses and other factors.**
- **Results in a decision.**

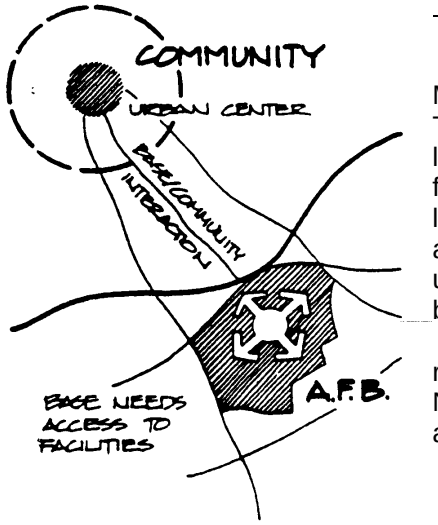
Over many years, transportation planners have developed an effective four-step process consisting of identification, evaluation, implementation, and monitoring.

Step 1. Identification - First, IDENTIFY THE GENERAL TRANSPORTATION SITUATION WITHIN AND AROUND THE BASE This is accomplished by defining transportation and other goals and objectives, performing an adequacy inventory of the current transportation system, forecasting changes which are expected to occur, and then analyzing these results for their current and future implications.

Step 2 Evaluation - DEVELOP AND EVALUATE ALTERNATIVE COURSES OF ACTION TO IMPROVE THE TRANSPORTATION SITUATION. This evaluation will lead to prioritized recommendations that can be directly included in the transportation part of the BCP.

Step 3. Implementation - A thorough transportation planning process will produce implementable recommendations. USE PLANNING AS A TOOL FOR MAKING DECISIONS TODAY THAT WILL MEET THE TRANSPORTATION NEEDS OF TOMORROW. Transform the prioritized recommendations into a five-year capital improvement program, which includes all short-term recommendations. The long-term recommendations will guide the implementation of the short-term improvements in facilities and services, as well as the land use plan.

Step 4. Monitoring - Systematic planning ensures that the transportation system continues to meet the needs both on-and off-base. USE PLANNING NOT AS A ONE TIME EFFORT, BUT RATHER AS A TOOL TO CONTINUALLY UPDATE THE BCP. To avoid obsolescence of the original transportation plan, maintain close interaction between the base and the community. monitor socio-economic or physical changes that affect the transportation plan, estimate their effects on the validity of the plan, and change the plan as necessary.



THE BASE AND THE COMMUNITY

THROUGHOUT THE PLANNING PROCESS THE PLANNER MUST RELATE TO THE NEEDS AND CONSTRAINTS OF BOTH THE BASE AND THE SURROUNDING COMMUNITY. Most bases are located adjacent to urban communities where a labor force and facilities for transportation, housing, supply, and related services are at least partially available. The greater the number of people employed and the higher the percentage of them residing off-base, the greater usually will be the interdependence of the community and the Air Force base.

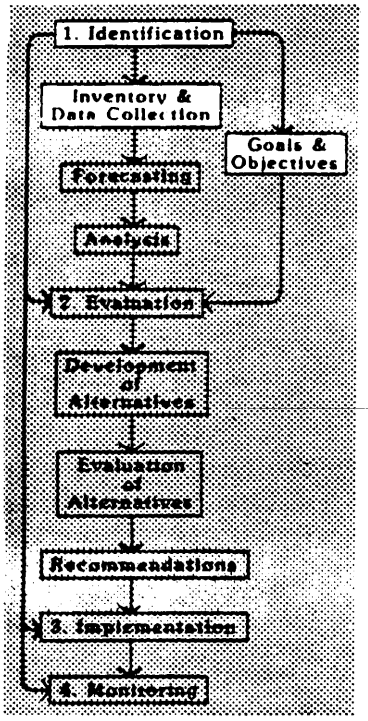
Communities and airbases often have common problems relating to land use development immediately adjacent to the base. New development can result in more traffic on the civilian road network and

more difficulty for persons accessing the base. Off-base roadway, transit service, or parking changes can also affect the ability of the base to effectively perform its mission.

In most areas, the basic highway and transit network extends outward from the community center in a radial manner. Such a network can serve the downtown area located at the focal point of the route, but it is less well adapted to serve an Air Force installation which usually is located at the periphery of the community.

A desirable transportation pattern provides the Air Force installation with good access to the maximum number of highways and transit services via routes that avoid congested areas. This pattern is also essential for maintenance of the Defense Access Road Program specified in AFR 75-88 (Ref.13). The base planner should coordinate these Air Force transportation "desires" with transportation plans being formulated in the community.

CHAPTER 2



GETTING STARTED: GOALS AND OBJECTIVES AND CURRENT INVENTORY

Before the transportation component of the Base Comprehensive Plan (BCP) can be prepared, the planner must define a starting point. First, establish some appropriate goals and objectives for improving transportation conditions. The goals and objectives provide guidance for the remainder of the planning process. Goals and objectives are important for handling everyday problems as well as for putting together an entire transportation plan.

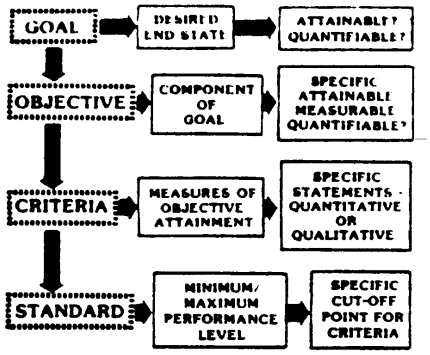
At the same time, conduct an inventory of current conditions. This inventory should include transportation, land use, and socioeconomic characteristics within the base and, to a lesser extent, in the community surrounding the base. The purpose of the inventory is to identify the scope and nature of any problems that exist, and to establish a data base of information from which to predict future conditions.

GOALS AND OBJECTIVES

Define appropriate goals and objectives to guide the transportation planning process toward a successful outcome. GOALS are general statements of desired ends and provide major direction to the planning effort. OBJECTIVES are developed from goals for evaluation purposes, and should be specific, attainable, and measurable. Further detail for evaluation is provided by CRITERIA and STANDARDS, as discussed in Chapter 5 and APPENDIX C.

Each goal may involve several objectives. One objective may serve more than one goal, and each objective may call for setting up a number of criteria. Collectively, there may be a dozen or more criteria by which to measure a plan's effectiveness in making progress toward several goals.

Table 2-1 depicts sample goals and objectives for Anytown AFB. APPENDIX C lists several other possible objectives with related criteria.



Mission

Base Goals

Transportation Goals

Transportation Objectives

TABLE 2-1. SAMPLE GOALS AND OBJECTIVES

Mission: Support "XX" Tactical Fighter Wing; Conduct Training in Missile and Aircraft Mechanics.

Overall Base Goals:

1. Ensure a High Quality of Life
2. Maximize Energy Efficiency
3. Optimize Land Use
4. Maximize Maintainability
5. Protect the Natural Environment

Example Base Transportation Goals: (Related to Overall Base Goal l)

1A. Provide a level of accessibility adequate to meet the needs of base personnel, their dependents and others.

1B. Provide a transportation system which offers maximum convenience and safety for base personnel and their dependents

Example Transportation Objective: (Related to Base Transportation Goal 1B)

- 1B-1 • Provide convenient access to traffic arterials
- 1B-2 • Minimize through traffic in residential areas.
- 1B-3 • Provide multipurpose pedestrian ways within and between neighborhoods
- 1B-4 • Provide adequate safety for auto travel and persons
- 1B-5 • Provide convenient access to shuttle bus

Goals and objectives may be divided further into short-and long-term statements. These eventually form policies and programs which give direction toward accomplishment of the goals and objectives.

Transportation goals are not totally separable from other base goals relating to land use, social environment, etc. Work closely with all participants in the BCP process to ensure that the transportation goals and objectives are compatible with the remainder of the BCP and with the goals and objectives in the surrounding communities.

DATA SOURCES

PUBLISHED DOCUMENTATION
- o TRAFFIC COUNTS
- o LAND USE
- o STUDY REPORTS

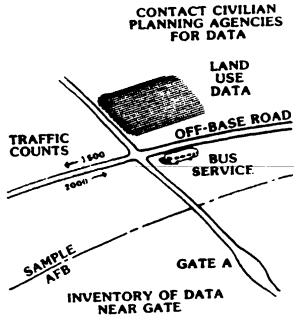
FIELD OBSERVATIONS
- o CONGESTION POINTS
- o ACCIDENT LOCATIONS
- o TRAFFIC PATTERNS
- o LAND USES
- o PARKING

TRAVEL SURVEYS
- o TRIP ORIGINS AND DESTINATIONS
- o TRAVEL MODES
- o TRAVEL BEHAVIOR

ACCIDENT RECORDS
- o LOCATIONS
- o FREQUENCIES
- o TYPES

AERIAL PHOTOGRAPHY
- o LAND USES
- o PARKING

STATISTICAL STUDIES
- o HISTORICAL TRENDS
- o FORECASTS



INVENTORY AND DATA COLLECTION

Understanding the relationships between land use, travel facility, 1/ and trip making characteristics is essential to good planning. Begin with a thorough inventory of current conditions. The required information, or data, are obtained through various sources, including published documentation, field observations, travel surveys, accident records analyses, aerial photography and statistical studies.

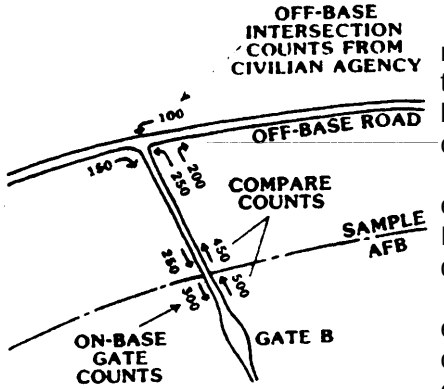
Once a thorough inventory has been completed on the base, an effective program for updating the data will keep the information valid for future planning efforts. Also contact the planning agencies in the communities outside the base for regional and local area data. The objective is to develop a systematic data acquisition and storage program that will include some studies carried out at regular intervals to monitor conditions and validate the data.

Most base planners must spend part of their time in planning, making, and using measurements. The planner should understand the basic principles of data collection in order to guide the necessary work. Refer to MTMC Pamphlet No. 55-8 (Ref. 5) and the Manual of Traffic Engineering Studies (Ref. 26) for details on data collection activities

Data collection must be carried out accurately, and for best results sound statistical procedures must be followed. In practice, professional judgment is often used in lieu of statistical rigor, which can be constrained by budgeting considerations.

The types of data collected and the methods used in obtaining them vary with the type of study being conducted. Typically, data are collected using a sample of the total data or "population". The size of the sample establishes the level of accuracy and reliability of the results. Table 2-2

1/ In transportation context, a travel facility may include roadways, parking lots, transit services or other infrastructure necessary to move persons and goods.



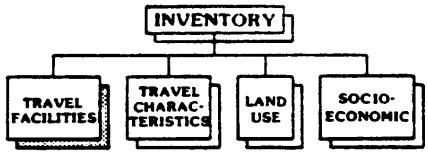
lists sampling techniques and typical examples of Air Force Bases.

Take every opportunity to check the accuracy of the measurements. For instance, compare the results of traffic counts taken at Gate A of Anytown AFB with those obtained outside the gate by a Civilian agency. If needed, adjust the counts to be more compatible.

Table 2-3 presents several typical situations on base. Beside each entry is a list of data that will be required to analyze the situation. In turn, refer to the page number at the top of each column to find the discussion of that inventory.

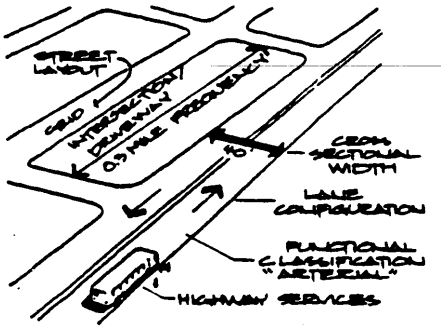
Use this table to help establish data inventory priorities. For example, if the base has poor circulation patterns the inventory should concentrate on a survey of streets and highways, vehicle and person counts, speed and delay measurements, origin-destination surveys and land use placements. Ultimately, a complete inventory is necessary to prepare the transportation plan component of the BCP.

TRAVEL FACILITIES



The inventory of travel facilities includes streets and highways, traffic control, transit features, parking supply, pedestrian and bicycle facilities, and various roadway services. Each of the categories is discussed below.

Streets and highways



STREETS AND HIGHWAYS PROVIDE ACCESS TO ABUTTING PROPERTY AND ALLOW MOVEMENT OF PERSONS AND GOODS. An inventory is performed to determine the relative weight given to these two functions. Collect enough detail about the physical and operating characteristic of each segment to calculate its capacity and physical condition for use in later planning.

Obtain the data from field surveys, road plans, pertinent maps, aerial photographs, construction plans, and elsewhere.

TABLE 2-2. TYPES OF SAMPLING

Time Period	Technique	Examples 1/
Location	Sample by Time Period	• Peak hour gate counts at all gates • Congestion problems; Weekend counts at BX and Environmental studies commissary • All day shuttle bus passenger counts
Statistical Fractions	Sample by Location	• Parking demand at officer's club, VOQ, etc. Localized problems; • 24-hour counts at Gates A and C only • Accident studies at selected locations •• Perimeter road traffic counts every 2 miles
Record All Data	Sample using Statistical Fractions	• Record every 3rd license plate entering each gate High volume locations; • Interview every 10th person leaving BX Lack of staff time or availability for data • Count traffic for 15 minutes and multiply by 4 to equal 1 hour Cost limitations
	Record all data (No sample)	• Inventory of road signs or markings Fixed facilities or • Inventory of parking spaces services • Number of shuttle bus trips

1/ More detailed examples of sampling techniques are given in Ref. 5 and 26.

Table 2-3. Index to Data Inventory Needs

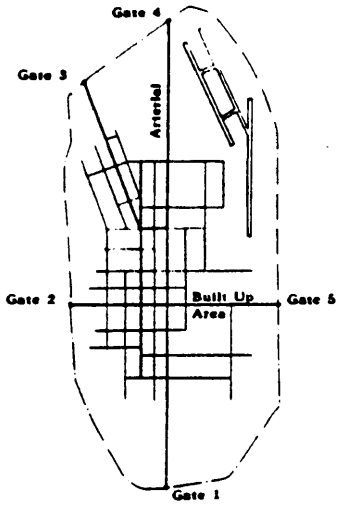
TYPICAL SITUATIONS	PAGE	TRAVEL FACILITIES				
		Streets and Highways	Traffic Control	Bus Services	Pedestrian/ Bicycle Facilities	Parking
		2-4	2-10	2-11	2-11	2-11
Congestion - usually occurs at specific locations such as BX, commissary, or employment sites.		Yes	Yes	—	—	Yes
New Development - new or relocated land uses create new trips on base		Yes	—	Yes	Yes	Yes
High accident locations - locations with high accident rates or severity of accidents.		Yes	Yes	—	Yes	—
Traffic through housing areas - heavy volumes and/or high speeds on local streets; resulting pedestrian accidents and noise.		Yes	Yes	—	Yes	—
Poor accessibility to land uses - indicated by backups at parking lot entrances/exits, lack of parking spaces, and excessively long walking distances.		Yes	Yes	—	Yes	Yes
Poor circulation - indicated by heavy turning movements and meandering travel paths. Misuse of a perimeter road can increase circulation problems.		Yes	—	—	—	—
Backups at gates - caused by inefficient security techniques, insufficient number of gates, poor gate location, or lack of capacity.		Yes	Yes	—	—	—
Lack of alternatives to the automobile - Lack of bus, carpooling, walking or bicycle facilities creates an overdependence on the auto, with resulting congestion.		Yes	—	Yes	Yes	Yes
Visual intrusion - overuse or misplacement of signs and parking areas can give a "scattered debris" look.		Yes	Yes	—	—	Yes
Inappropriate land development - plans for land development that run counter to transportation plans.		Yes	—	Yes	—	Yes
Other -					—	

Note: Read through Chapter 2 to select data inventory needs for specific on-base situations.

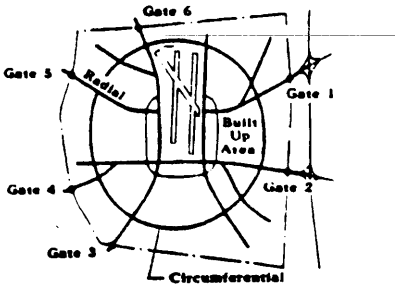
Table 2-3. Index to Data Inventory Needs (CONT'D)

TRAVEL CHARACTERISTICS						LAND USE	SOCIOECONOMIC CHARACTERISTICS
Vehicle Counts	Person Counts	Bus Use	Travel Times, Speeds, Delay	Origins - Destinations	Accidents		
2-15	2-18	2-19	2-21	2-21	2-24	2-26	2-27
Yes	Yes	—	Yes	—	—	—	—
Yes	Yes	Yes	—	Yes	—	Yes	Yes
Yes	—	—	Yes	—	Yes	—	—
Yes	Yes	—	Yes	—	Yes	—	—
Yes	Yes	—	Yes	Yes	Yes	Yes	Yes
Yes	Yes	—	Yes	Yes	—	Yes	—
Yes	—	—	Yes	Yes	Yes	—	—
Yes	Yes	Yes	—	Yes	—	Yes	Yes
—	—	—	—	—	—	Yes	—
—	—	—	—	Yes	—	Yes	Yes

Note: Read through Chapter 2 to select data inventory needs for specific on-base situations



GRID STREET SYSTEM



RADIAL-CIRCUMFERENTIAL SYSTEM

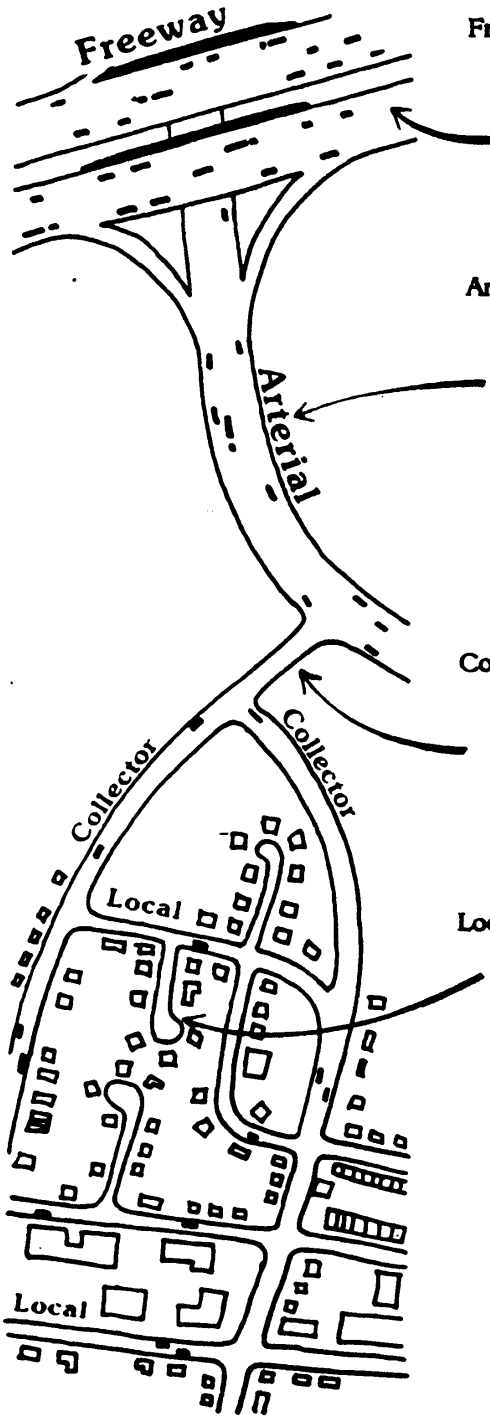
Many of these data are available from the base civil engineering office and community planning offices or departments of public works.

Street systems on Air Force Bases generally follow one of two basic patterns, or a combination of these two. One is the grid pattern; the other is the radial-circumferential pattern. The GRID system, resembling a checkerboard, is a series of streets located at approximate right angles to each other. These streets produce blocks that are either square or rectangular.

The RADIAL-CIRCUMFERENTIAL system consists of a series of major streets radiating from the built-up central area of an installation. These radials are supplemented by a series of circumferential streets that encircle the built-up area. RADIAL streets provide direct travel between the outskirts and the built-up area of an installation. These routes adapt easily to topography and, therefore, usually are established quite naturally except where prevented by deliberate planning or by major physical features (e.g., ravine, water, hill, etc.). CIRCUMFERENTIAL streets, on the other hand, permit travel from one point to another in the outskirts of the installation without going through the built-up area. Anytown Air Force Base has a circumferential Perimeter Road combined with radial and grid streets on both sides of the airfield.

The primary characteristic of each road is its FUNCTIONAL CLASSIFICATION. The classification system is necessary for communication among planners, administrators, and the public. For transportation planning purposes, the main considerations for classifying roads are travel desires of the road user, land needs based on existing and expected future land use, and overall road-system continuity. There are five roadway classes which meet these needs-freeway, expressway, arterial, collector, and local. This terminology varies from jurisdiction to jurisdiction; however, the functions are consistent. See Figure 2-1 and Table 2-4 for functional roadway characteristics.

FIGURE 2-1. ROADWAY CLASSIFICATION



Freeways and Expressways

- Serve large volumes of **through** traffic
- Full or parttime access control.
- Opposing direction lanes are divided
- No adjacent land uses are directly served.

Arterials

- Serve large volumes of through traffic (**major** arterial) or localized, shorter distance traffic (**minor** arterial).
- Access to abutting land is restricted, to maintain high-level traffic service (e.g., one curb cut every one-eighth mile).
- Act as boundaries of housing and community areas.
- Connect to collector streets.

Collectors

- Collect traffic from housing or community areas and move it to or from the arterial streets.
- Provide direct access to abutting land uses.
- Regulate speed to ensure safe and efficient traffic flow.

Local Streets

- Provide direct access to adjacent land uses.
- Have minmal parking or traffic controls except for slow speed limits.
- May be divided into subclasses accordingly to type of land served:
  - Residential - access to housing units typically on short or dead-end streets.
  - Administrative/Community - access among administrative or shopping uses with access to collector.
  - Industrial - access to industry for authorized vehicles and employees.

TABLE 2-4. CHARACTERISTICS OF ROADWAY CLASSES

CRITERIA	FREEWAYS & EXPRESSWAYS	ARTERIAL	COLLECTOR	LOCAL
Average Trip Length (mi.)	Over 3	Over 1	Under 1	Under 1/2
Average Travel Speed (mph)	50-55	25-45	25-35	25-30
Average Daily Traffic Volume (Both Directions)	25,000 to 100,000	8,000 to 25,000	2,000 to 8,000	fewer than 2,000
Access Control	Partial to Full	Partial	Minimum to Partial	Minimum
Service to Activities	Through Traffic high volume	High to Med. Vol.	Local Areas Neighborhoods	Individual sites
Spacing (mi.)	2 or over	1/2 - 1	1/4 - 1/2	300-500'
Traffic Control	Free Flow	Traffic Sig. Stop signs	Stop Signs Traffic Sig.	Stop sign or yield
Average No. of Lanes	4 to 8	4 to 6	2 to 4	2

On most bases, there will be a heavy concentration of arterial, collector, and local streets, while a major arterial may provide a primary spine. Few bases have freeways and expressways, although these roads often provide access to/from the base. Refer to APPENDIX A for the roadway classification on Anytown AFB.

Each classification carries a set of suggested minimum design standards. These standards are in keeping with importance of the roadway system and are governed by the specific service the system is expected to provide. Design standards are provided in Ref 7. and 41.

Traffic Control

Make an inventory of all in-place traffic control devices as required in AFR 75-88 (Ref. 12) for the highway safety program. This record is essential for planning future needs, scheduling maintenance, and ensuring that all devices conform to current standards. Standards are important for

TRAFFIC CONTROL DEVICE INVENTORY

- TYPE OF CONTROL DEVICE
- DESCRIPTION OF DEVICE
- LOCATION INFORMATION

- AUTHORITY FOR ITS INSTALLATION AND USE
- IN-PLACE HISTORY

This inventory can be kept manually or in a computer file. A map of signals and/or signs is also a handy reference. This inventory is closely related to the required accident inventory. Procedures for performing the traffic control device inventory are given in MTMC Pamphlets No. 55-8 (Ref. 5) and No. 55-11 (Ref. 8).

Bus Services

SHUTTLE BUS INVENTORY

- ON-BASE ROUTES
- SCHEDULE OF SERVICE
- NUMBER OF BUS TRIPS
- BUS STOP LOCATIONS
- TYPE Of BUSES USED
- MAJOR LAND USES SERVED

Conduct an inventory of on-base shuttle bus service as well as any bus service linking the base to the adjacent community. Contact the base engineer for relevant shuttle bus information. Work through the local transit agency in the community to obtain data on off-base services.

The bus inventory is used for future route planning, evaluation of present operations, and planning additional or fewer stops. The bus inventory can also be used to determine whether the bus schedules fit with duty hours of base personnel.

Portray these data on a sketch map or Tab overlay and in tabular summaries of service and equipment. A description of a bus user inventory and an example overlay from Anytown AFB are provided in the Travel Characteristics section of this chapter.

Pedestrian and Bicycle Facilities

PEDESTRIAN AND BICYCLE FACILITY INVENTORY

- SIDEWALKS AND PATHWAYS
- CROSSWALKS
- PEDESTRIAN SIGNALS AT INTERSECTIONS
- BARRIERS AND REFUGE ISLANDS
- LIGHTING
- HANDICAPPED USER PROVISIONS
- SAFE ROUTES TO SCHOOL
- BICYCLE STORAGE FACILITIES

Make an inventory of on-base pedestrian, bicycle or other special purpose transportation facilities. This should be performed along with the streets and highways inventory to determine the quality of facilities for non-motorized travel. Display this information on a sketch map with supporting descriptions (See Figure 2-2). Analyze the pedestrian and bicycle facilities inventory in relation to the

a safe transportation system on base and for conformance with off-base conditions. Traffic control devices include signs, pavement markings, and traffic signals, as defined in the Manual on Uniform Traffic Control Devices (Ref. 47)

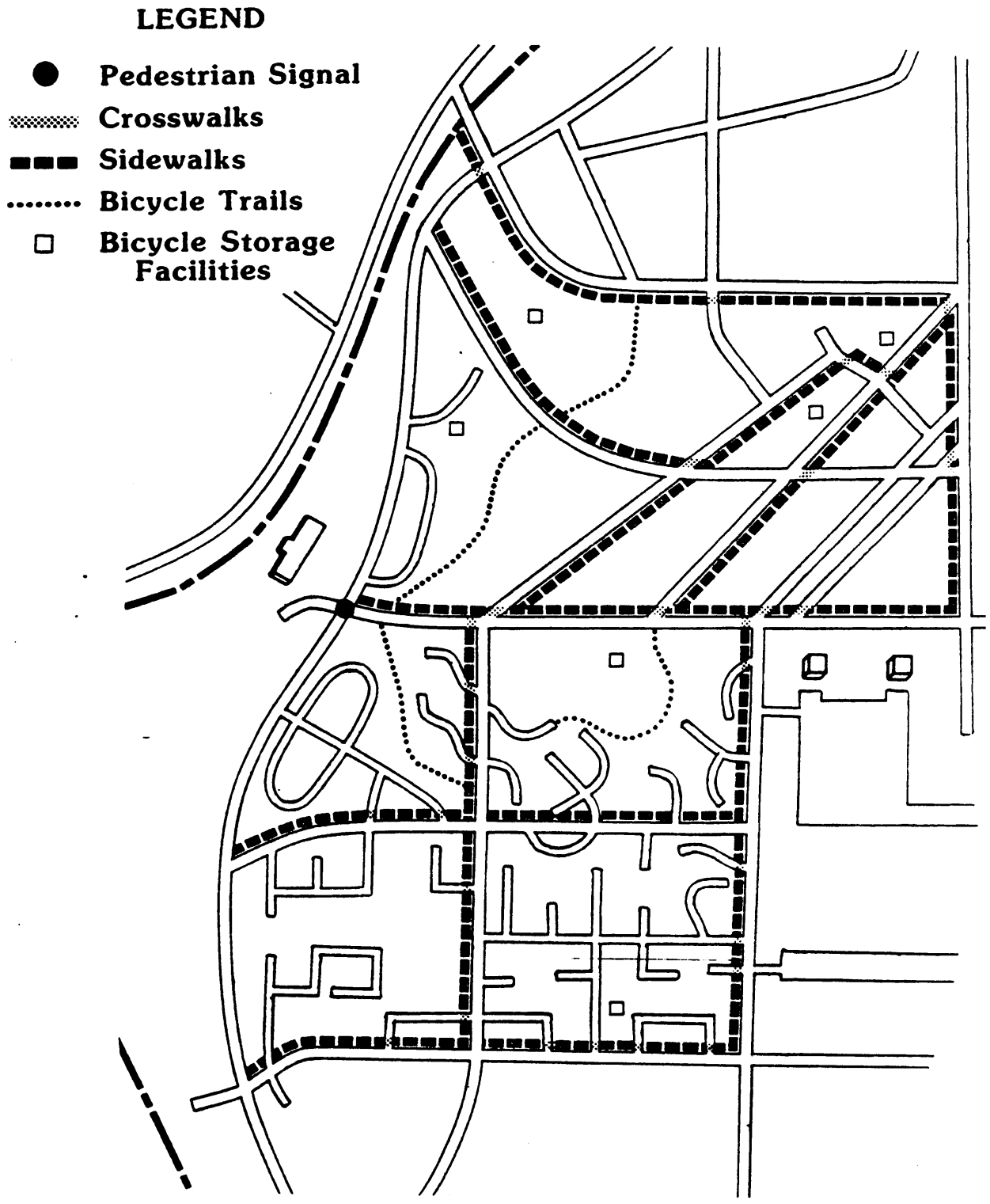


Figure 2-2. Pedestrian and Bicycle Facilities

overall street plan, in order to identify conflicts with vehicles and levels of access provided to major traffic generators.

Parking Supply Inventory

A parking inventory includes location, design and other legal restrictions on the use of on- and off-street parking spaces and their points of access. It provides necessary data for analyzing parking space usage and for relating parking supply to demand. It is useful in determining locations for potential development of additional parking facilities, locations for additional land uses that will generate parking requirements, and changes required in parking regulations. Aerial photographs are very useful in performing the parking inventory.

PARKING INVENTORY

- NUMBER OF EXISTING SPACES
- RESTRICTIONS (IF ANY)
- ON-STREET OR OFF-STREET
- LOCATION RELATIVE TO LAND USES
- CIRCULATION PATTERNS IN LOT

PARKING SUPPLY is the actual number of spaces available, both on-street and off-street, to serve parkers within a reasonable walking distance of their destination. In addition to counts of the actual number of spaces, the information collected should include the parking time limits (if any) of the spaces. If the spaces are located off-street, physical characteristics of the lots should be noted. The characteristics should include entrance and exit locations; type of surface; circulation pattern; and dimensions of aisles, spaces, and entrances. The base security police officer normally maintains an inventory of parking spaces and an identification reserved parking spaces.

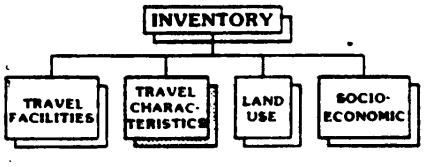
On-street and off-street information are combined on sketch maps that show the total number of parking spaces available in each section of the base. Lots with greater than 25 spaces are delineated. Further details on the conduct of parking inventories are given in Ref. 5 and 26. Parking usage surveys and an example from Anytown AFB are described in the travel characteristics section of this chapter.

Roadway Services

The final step of the travel facilities inventory is to identify unique roadway service functions on the base. These could include the following:

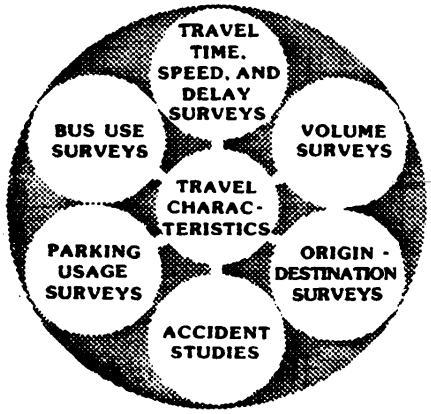
- Roadways designated for emergency vehicles, alert crew, or hazardous material movements.
- Roadways grouped according to maintenance priorities (roadway surface repair, snow plowing etc.). Include appropriate references to the administrative system for roadway maintenance on base.

Knowledge of these features is important for evaluating various actions and for making recommendations for their inclusion in the BCP.



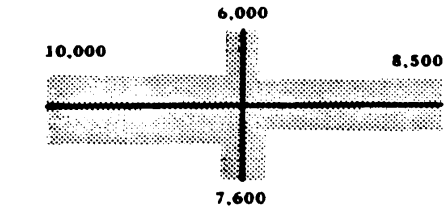
TRAVEL CHARACTERISTICS

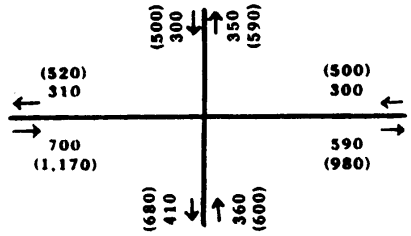
This inventory determines how many people use the transportation system, who they are, and their travel patterns. Data are gathered primarily from studies of traffic volume, vehicle occupancy, travel time and delay, trip origin and destination and accidents. These operating characteristics of the street and highway system help identify the existing levels of congestion and other problems, and are the basic information required for estimating future travel demand.

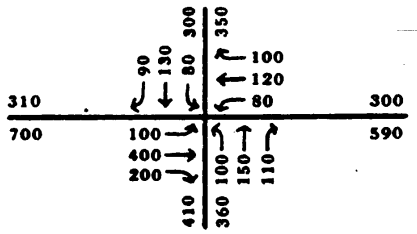


Volume Surveys

Volume surveys are obtained for vehicles and persons using survey techniques detailed in MTMC Pamphlet No. 55-8 (Ref. 5) and in the Manual on Traffic Engineering Studies (Ref. 26). A brief discussion of each type of survey is presented below.







Traffic Counts

A traffic volume or flow study is the measure of the time rate of vehicles passing a specific point on a roadway. This count may be stratified by time of day, direction of travel, type of vehicle, and number of vehicle occupants The scope may range from a comprehensive survey on all facilities to a single count at an Intersection.

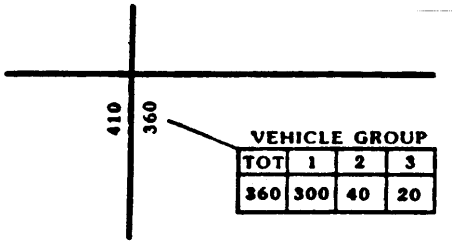
Traffic volume counts provide the planner with essential information on the amount of usage of the roads in the highway system. This information is needed for the determination of design standards, the systematic classification of highways, and the development of programs for their improvement and maintenance.

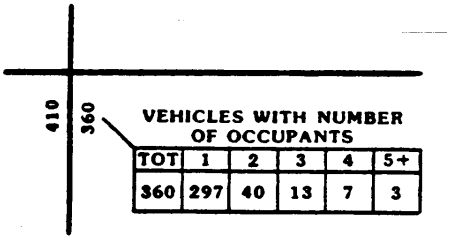
Typical types of traffic volume surveys are the following:

- Average Daily Traffic (ADT) - These are 24-hour counts on a roadway link averaged over a stated period of time. This is the fundamental index of usage of a street.

- Peak Hour Traffic - These are counts taken during the highest volume or PEAK HOUR, either in the morning (AM) or evening (PM) peak. PEAK PERIOD counts can also be made covering heavy volumes on both sides of the peak hour and the peak period.

- Turning Movements - These are counts showing activity at an intersection (left turns, through movements, and right turns). They usually represent the peak hour of a morning, noon, or evening traffic period.





• Vehicle Classification Count - These counts separate the traffic into different vehicle types for pavement design and environmental purposes. They are collected for any time period but preferably during both a peak and off peak period of the workday. Vehicles are often grouped according to size and number of axles, as follows:

1. Passenger cars, panel and pickup trucks, and motorcycles

2. Two-axle trucks and buses

3. Trucks with three or more axles

• Vehicle Occupancy Count - These counts distinguish among passing vehicles according to the numbers of persons riding in the vehicle (e.g., l person, 2, 3, 4, 5+).. They are usually collected during the morning peak hour for inbound traffic only with these counts, an average vehicle occupancy can be calculated as follows:

Persons per vehicle		No. of vehicles counted		Total No. of occupants
1	x	297	=	297
2	x	40	=	80
3	x	13	=	39
4	x	7	=	28
5	X	3	=	15
		360		459

Average Vehicle Occupancy = 459/360 = 1.27
Rounded to equal 1.3 persons- per vehicle

Counts may be taken in one or both directions on a roadway, either manually or with automatic counters, as listed in Table 2-5. Automatic counters and manual counting boards often may be borrowed from the local civilian traffic engineering or public works departments, or occasionally from the base engineer. Many manual counts only require a clipboard, tally sheet, and pencil (see Ref. 5).

TABLE 2-5. COUNTING TECHNIQUES

	Factor	Manual	Automatic
Type of Count	Type of Count		
	Roadway Links	X	X
	Intersection		
	-	Approach Volumes	
	X	X	
Length of Count	-	Turning Volumes	X
	-	Right-Turn-on-Red	X
	Classification	X	
	Occupancy	X	
Direction of Travel Counted	Special Counts		
	-	Vehicles Parking	X
	X		
	-	U-turns	X
	-	Military Vehicles	X
	-	Pedestrian	X
Weather	Length of Count		
	Short Term (e.g., peak		
		hour, peak period)	X
	X		
	Long Term (i.e., greater		
		than 12 hours)	X
	Direction of Travel Counted		
	Both Directions Together		X
	Each Direction Separately	X	X
	Each Lane Separately	X	Not Usually
	Weather		
	Snow, Ice	X	Not Reliable

Person Counts

Counts of person volumes are made for several purposes: to record movements of persons onto and from the base, to determine the extent of ridesharing, etc. other purposes include the determination of entrance/exit-gate statistics, parking demand, the need for carpool formation or transit improvements, the need for pedestrian facilities and the need for MTMC traffic planning services.1/

Two basic types of person counts are performed -- vehicle occupancy counts and pedestrian counts. VEHICLE OCCUPANCY counts measure the number of persons riding in each vehicle passing a selected point. Typical time periods are the morning and evening peak hours when employees are arriving for duty or going home. vehicle occupancy and PEDESTRIAN counts are taken at major gate entrances/exits and in the vicinity of major activities, such as the BX, Commissary, other shopping or employment centers. See Reference 5 for more details.

Parking Usage Surveys

Parking usage surveys measure characteristics and demand. Lack of convenient parking is a significant problem on many bases. The problem is usually localized in certain portions of the base--commissaries, exchanges, housing areas, and employment concentrations. Parking survey results are used to determine the proper size, placement, and controls for parking facilities throughout the base. Parking areas reserved for military vehicles in general or for specific types of military vehicles (e.g., flightline or POL areas, or motor and equipment pools)

PARKING USAGE STUDIES

- o DURATION
- o OCCUPANCY
- o DESTINATIONS

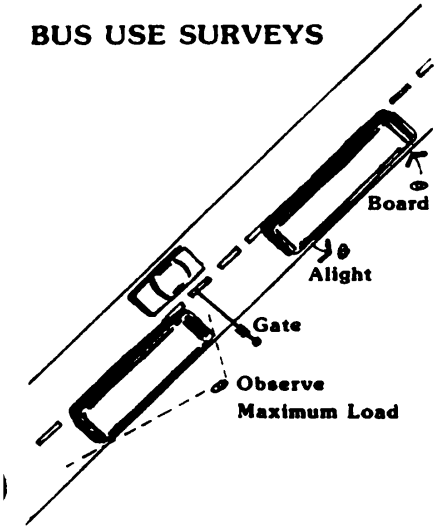
_____

1/ A record of average vehicle occupancy over a period of time may be used as a measure of compliance with Air Force policy (AFR 75-88) regarding ridesharing promotion. MTMC will not commit resources for transportation engineering studies for minor problems unless the base can show that an effort has been made to reduce traffic through ridesharing and other means.

typically are studied separately because of their special characteristics.

The primary data to obtain in parking usage studies are DURATION and OCCUPANCY, as described in References 5 and 26. Some studies are designed to obtain information only on occupancy; others provide data on both occupancy and duration, permitting a determination of parking accumulation during the course of a day. Authorized and unauthorized parking should also be checked. Figure 2-3. shows an example of a parking occupancy survey together with a parking space inventory.

In many cases, there is a need to know the DESTINATIONS of the persons parked in the spaces. This is particularly important on bases where persons park a significant distance away from their destinations owing to parking shortages closer in. These characteristics usually are obtained through a "windshield" survey form which is mailed back by the parker, although personal interviews-can also be used. In employee parking areas, destinations can be estimated by checking base decals against vehicle registration records to determine home location, zip code, and duty station of the owner-operators.



Bus Use Surveys

Conduct bus use surveys together with traffic counts and vehicle occupancy counts in order to have compatible data. A separate analysis of personnel duty hours is required to determine if the shuttle bus or local bus service meets the needs of base personnel.

The following transit use data are collected:

- Load checks - occupancy counts are taken on buses at or near the maximum load point(s) or at major stops on the base (e.g., the main gate).
- Boarding and alighting checks - on-board counts record the number of passengers boarding and alighting at each bus stop.

1. Create Parking Analysis Areas.

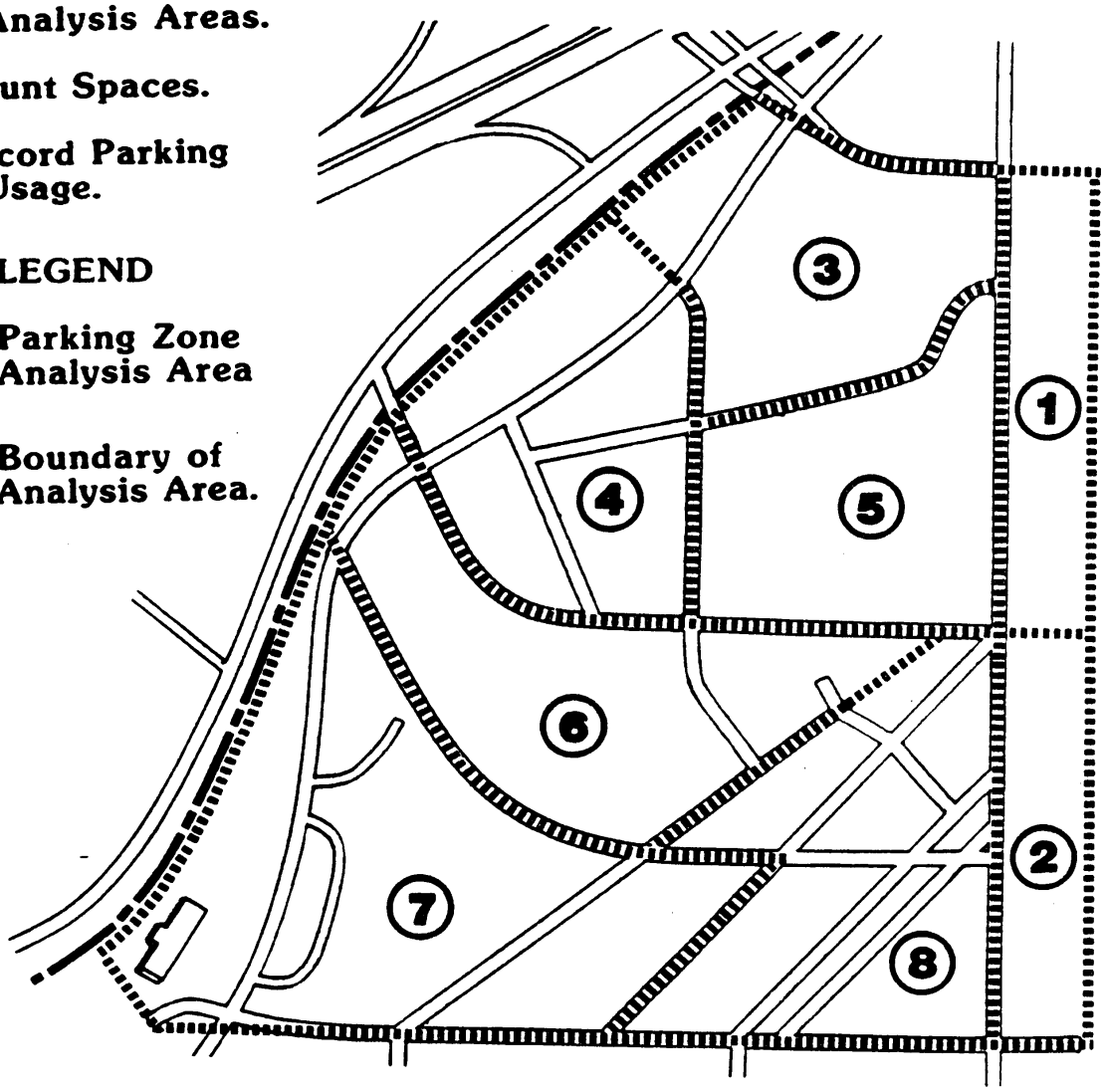
2. Count Spaces.

3. Record Parking Usage.

LEGEND

○ Parking Zone Analysis Area

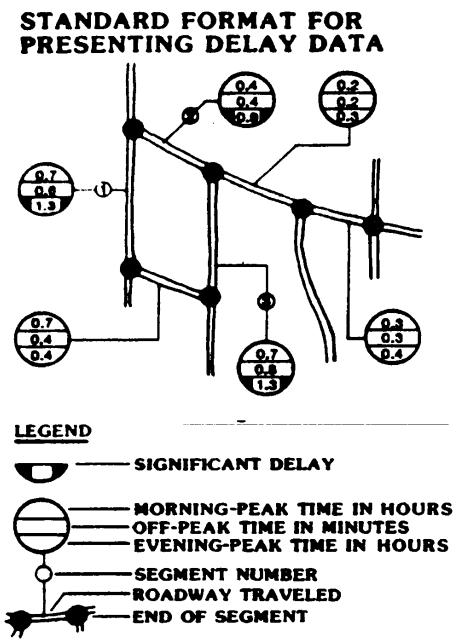
⋯⋯ Boundary of Analysis Area.



PARKING INVENTORY

PARKING ANALYSIS AREA ZONE	OFF STREET				ON STREET				TOTAL		% FILLED	TOTAL		% RES
	UNRESERVED		RESERVED		UNRESERVED		RESERVED							
	EMPTY	FILLED	EMPTY	FILLED	EMPTY	FILLED	EMPTY	FILLED	EMPTY	FILLED		UNRES	RES	
1	170	22	7	11	0	0	0	0	177	33	15.7	192	18	8.6
2	213	126	13	26	23	37	0	0	253	187	42.5	401	39	8.9
3	53	132	43	113	7	50	2	6	105	301	74.1	292	164	40.3
4	163	244	165	144	1	27	0	0	289	415	59.8	615	289	41.1
5	15	276	126	379	3	35	2	12	146	702	82.8	329	519	61.2
6	135	412	10	2	0	0	0	0	145	414	74.1	547	12	2.1
7	660	370	36	44	0	0	0	0	696	414	37.3	1,030	80	7.2
8	377	581	264	643	0	32	0	0	641	1,256	66.2	990	907	47.8
									(2,452)	(3,722)	60.4	(4,146)	(2,028)	32.9
Total	1,768	2,163	646	1,360	36	181	4	18	6,176			6,176		

Figure 2-3. Parking Inventory



For shuttle bus routes, the load check and boarding - and - alighting checks can be made with observers equipped with data sheets and stop watches. Reference 5 has copies of necessary data sheets. The load check is performed from a stationary location; boarding - and - alighting checks are made by observers riding the shuttle buses. These data for off-base buses can usually be obtained from the local transit systems. Figure 2-4 presents the results of an inventory of bus routes, schedules and use on Anytown AFB.

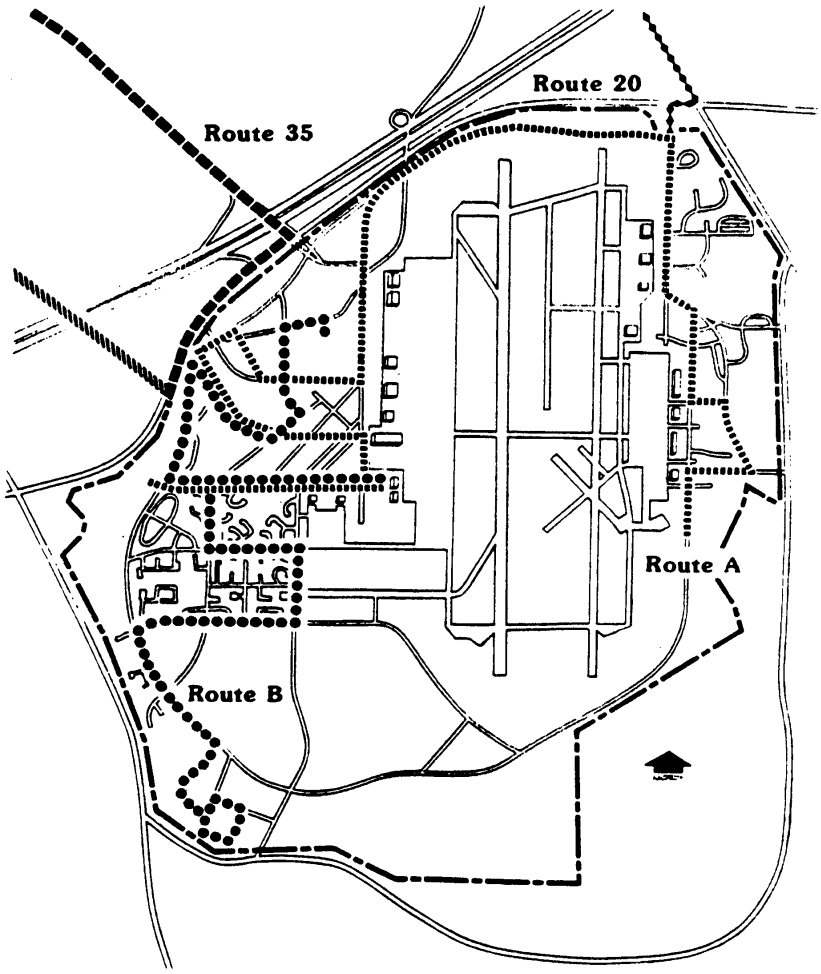
Travel Time, Speed, and Delay Surveys

These surveys determine typical travel times, speeds and delays experienced by motorists on the base. In planning travel time measurements, decide whether both peak and off-peak conditions are to be studied since these characteristics vary with time of day. Figure 2-5 depicts typical procedures used for travel time, speed, and delay studies.

Travel time speed, and delay data are useful for checking reasonableness and compliance with posted speed limits, for identifying causes of congestion, for determining need for new traffic controls, for relating speed to frequent accident locations, and for determining the after-effects of roadway or land use changes. They also can be used to analyze base specific concerns such as pedestrian conflicts, security at gates and other locations, and movement of special equipment or hazardous materials. Refer to Reference 5 for data forms and map displays.

Origin-Destination Surveys

Origin-destination (O-D) surveys are used to determine the travel desires of the population in and around the base. An ORIGIN is the starting point of a trip and a DESTINATION is the ending point. Origin-destination surveys are used in the comprehensive planning process to



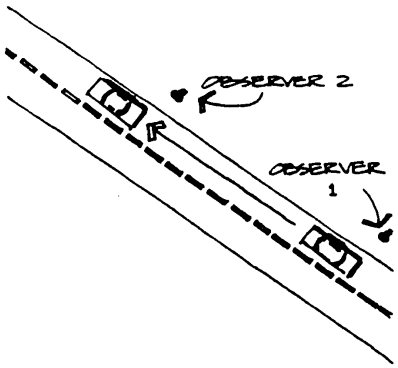
BUS ROUTE CHARACTERISTICS

Shuttle Bus Routes	Hours of Operation	Number of one-way bus trips	Frequency of service	Daily Ridership	Comments
A	Weekday 0600-1800	24	30 min.	480	Serves both sides of base
	Weekend 1000-1800	8	60 min.	130	
B	Weekday 0600-2400	36	30 min.	550	Serves west side land uses
	Weekend 0800-1800	10	60 min.	110	

Off-base Routes	Hours of Operation	Number of one-way bus trips	Frequency of service	Daily Ridership	Comments
20	Weekday AM & PM Peak Periods only	AM-5 PM-3	AM-30 min. PM-30 min.	160[1/]	Turns around at Gate F
35	Weekday 0430-2400	46	Peak Period-15 min. Off Peak Hours-30 min.	1150[2/]	Route passes gates A & B on offbase road
	Saturday 0800-2100	13	60 min.	200[2/]	
	Sunday 0800-2140	17	60 min.	250[2/]	

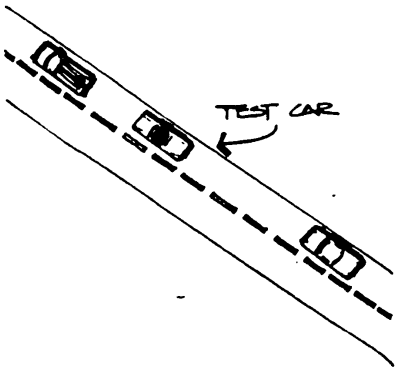
1/ Boarding/alighting checks at Gate F
2/ Load checks along offbase road

Figure 2-4. Bus Inventory



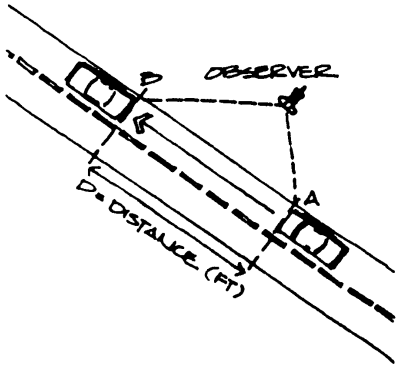
LICENSE PLATE METHOD

1. Observer #1 records license plate or military decal number and time (08:15).
2. Observer #2 records license plate or military decal number and time (08:21).
3. Match license plate or decal numbers and subtract time 08:21 - 08:15 = 00:06 = 6 min.



FLOATING - CAR TECHNIQUE

1. Test car with driver and observer "floats" with the general traffic stream.
2. Record elapsed time between points and length of delay at specific locations.



SPOT SPEED STUDY

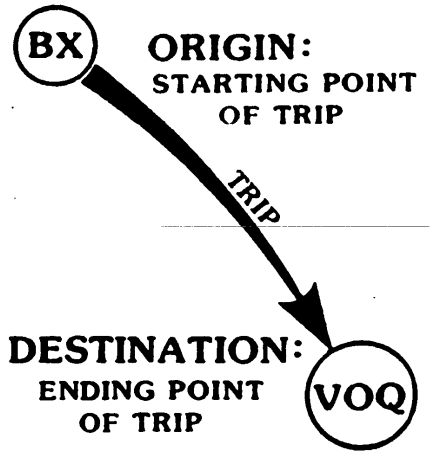
1. Observer records time (T) in seconds for vehicle to travel between lines A & B on pavement.
2. Calculate speed (S) using formula:

$$S = \frac{D}{(1.47 \times T)} = \text{mph}$$

ALTERNATE

1. Record speeds with radar gun (available from security police or law enforcement agencies).

Figure 2-5. Travel Time, Speed and Delay Studies



determine new or revised highway routes, the optimum locations and sizes of entrance gates and parking lots, applicable duty hour distributions, the potential for carpooling, and the design of bus routes and facilities. They are particularly helpful in determining the amount of through traffic in a housing area or nonbase traffic through a base. Because a base is largely self-contained, with specified entrance/exit gates, an origin-destination survey can be performed efficiently.

An O-D survey can aid in distinguishing the different patterns of travel among on-base land uses. For example, the hospital/medical complex often is used by both on-base personnel and retirees from adjacent communities. The travel patterns for this land use would therefore be much different from those of other land uses (e.g., housing office) that are used primarily by on-base personnel.

There are various procedures for conducting an O & D survey. Among the most prevalent are the personnel questionnaire, personal interview and license plate survey shown in Figure 2-6. A copy of a questionnaire used on Anytown AFB is shown in Appendix D.

Other origin-destination survey techniques described in Reference 26 include parked vehicle license plate surveys, motor vehicle owner mail questionnaires, bus on-board surveys, and truck and taxi surveys. These techniques are less applicable on military bases, but are often used outside of the base by civilian planners. Therefore, compare the data from any on-base origin-destination survey with results from other regionwide surveys to make sure that the results are reasonable.

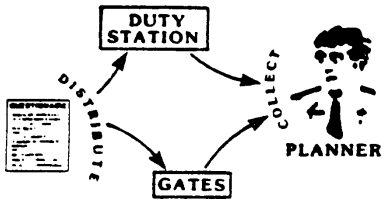
CONTENTS OF O & D SURVEY

- ORIGIN OF TRIP
- DESTINATION OF TRIP
- TRIP PURPOSE
- TRIP MODE
- ASSIGNED DUTY HOURS
- ENTRANCE GATE USED
- PARKING LOCATION
- VEHICLE OCCUPANCY

Accident Studies

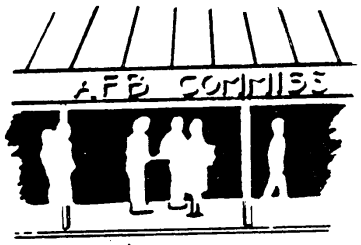
Accidents are studied in an attempt to reduce the accident rate on the installation. Accident data are used in a planning sense to point out where and when traffic accidents are a critical problem to suggest lines of

O & D SURVEYS



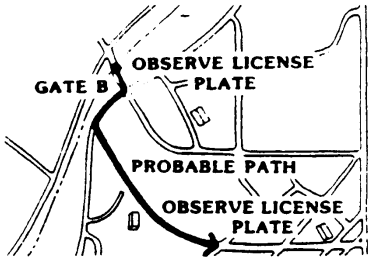
PERSONNEL QUESTIONNAIRE

Establish distribution and collection system for questionnaires.



PERSONAL INTERVIEWS

Conduct interviews with persons along roadways, at gates, and at major traffic generators.



LICENSE PLATE SURVEYS

Match license plates at several locations to trace the vehicle paths.

Figure 2-6. Origin-Destination Surveys

ACCIDENT DATA NEEDS

- o LOCATION
- o DAY OF WEEKTIME OF DAY
- o SEVERITY
- o TYPES OF VEHICLES
- o PEDESTRIAN INVOLVEMENT
- o MOVEMENT OF VEHICLE (S) IN ACCIDENT
- o PROBABLE CAUSE
- o HIGH-ACCIDENT-FREQUENCY LOCATIONS

preventive action, and to measure the effect of accident prevention efforts.

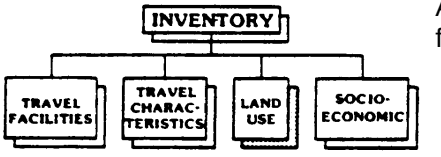
The best sources for accident data are the security police or base safety office. They normally maintain an accident spot map for the base showing all accidents during the past year by severity and time of day. In addition, specific accident reports should be available for each identified spot on the map. `The base Traffic Safety Management Committee serves as an advisory group for consideration of safety problems.

A road location may have numerous accidents because it is heavily used rather than because it is especially hazardous. Therefore, examine the number of accidents relative to the average daily traffic volume in order to establish high accident - frequency locations. The Highway Safety Program Standards 13 (see Ref. 13) requires that the base have an ongoing program to reduce the number and severity of traffic accidents. The Air Force Highway Traffic Safety Program in AFR 127-7 (Ref. 16) gives specific guidance in this area.

LAND USE

Land use patterns delineate by area the various functions on the land and are basic factors in determining transportation demands of a base. Land use and transportation plans must be developed side-by-side. Each possible land use alternative may suggest one or more transportation systems, each of which, in turn, can determine the feasibility of a particular land use proposal.

For these reasons, an important part of the transportation planning process is to obtain an accurate land use survey that identifies and classifies land uses in a systematic fashion. AFR 86-4 (Ref. 15) has designated specific land use categories and map patterns (See APPENDIX D for BCP categories and a sample Tab overlay). In multi-function buildings the predominant use, usually in

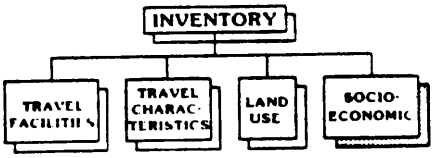


OBJECTIVES OF LAND USE SURVEYS

1. PROVIDE LAND USE DATA BASE:

   A. CURRENT CONDITIONS
   B. FUTURE NEEDS

2. PROVIDE BACKGROUND DATA FOR ORIGIN/DESTINATION OR HOME INTERVIEW SURVEYS



TYPES OF LAND USE SURVEYS

- BUILDINGS
- VACANT LAND
- STRUCTURAL
- ENVIRONMENTAL
- LAND VALUES
- AESTHETIC FEATURES

terms of area occupied, determines the land use category. For example, a large warehouse with some administrative space should still be carried in the "Industrial" land use category. Assign each facility a BCP category.

Once the land uses are categorized, begin the task of planning and carrying out a land use inventory. (This topic is discussed more fully in the Land Use Planning Bulletin - Ref. 1). Select the type of inventory based on the purpose of the study and on the resources available. A land use survey may not always require entering a building. However, access to specific buildings may be necessary to collect data on floor area usage and to determine structural condition.

Examine current land use maps available on the base and update them where necessary. Most bases have manually developed land use maps, although computer graphics displays will become prevalent in the future. Record the new land use data either directly onto maps or air photos, or more recently, onto computer-readable data sheets for entry into a land use data base. For planning purposes, several similar buildings can often be grouped together into larger zones, for which composite characteristics are described. These characteristics are later used to forecast traffic on the base (see chapter 3)

SOCIOECONOMIC CHARACTERISTICS

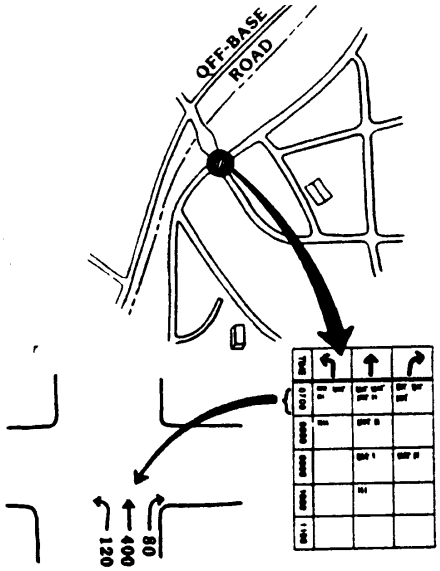
Socioeconomic inventories establish past and current facts about the users of the base. The key ingredients are POPULATION and EMPLOYMENT data, although data on housing, duty hours, and security measures may also be assembled. These data are used primarily as a basis for forecasting growth potential, for use in origin and destination surveys, and for determining trip generation (see Chapter 3).

The transportation planner physically does not collect social and economic data; rather, the planner uses these

SOCIOECONOMIC DATA

PRIMARY
- o POPULATION
- o EMPLOYMENT

SECONDARY
- o INCOME
- o AGE
- o AUTO OWNERSHIP
- o HOUSEHOLD SIZE
- o DUTY HOURS
- o RANK



USE SUMMARY DATA FOR

- **ASSESSING CURRENT CONDITIONS**
- **FORECASTING FUTURE CONDITIONS**
- **EVALUATING ALTERNATIVE PLANS**

data, together with land use characteristics, as input to the transportation planning process. The most common source is the decennial census conducted by the Census Bureau. In the near future, planners will have access to an Installation Specific Data Base (ISDB), which is a computer record of base characteristics. This data base will complement the Environmental Technical Information System (ETIS), which is currently available to planners for examining social-economic characteristics in areas outside the base. The ETIS is used for data base management as well as for impact modeling.

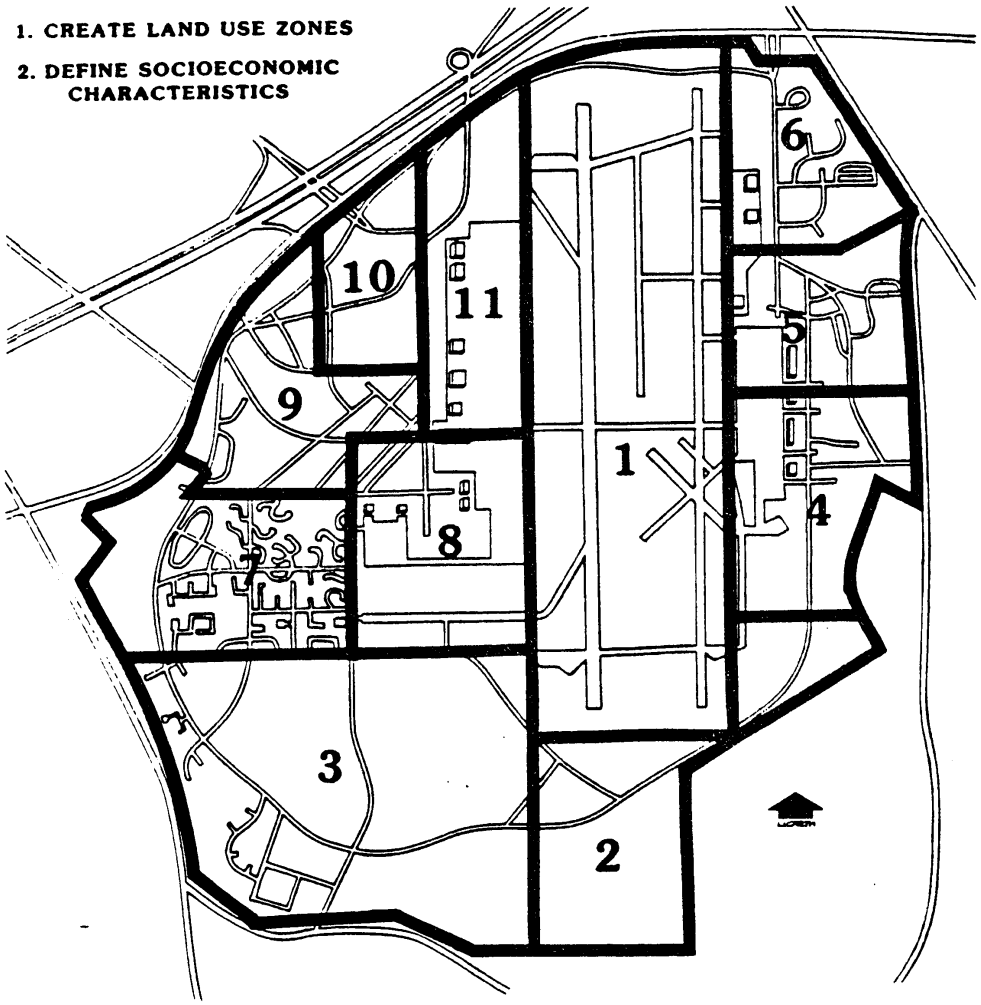
Record the social and economic data for specific areas, or zones, on the base. An example from Anytown AFB is provided in Figure 2-7. On a base with frequent changes of personnel and functions, social and economic data will require continual updating using the resources of the Accounting and Finance, Civilian Personnel, and Housing offices. The ISDB will allow each base to maintain more complete and updated files and can be expanded to include the unique missions and tenants on specific bases.

DATA SUMMARY

The value of transportation data depends in part on the way they are used. By careful data summary and subsequent study, the planner can discover trends and characteristics not necessarily apparent from the original data or from field observation.

Convert data obtained from its initial, or "raw" state into formats usable for subsequent planning. If a sampling technique has been used, the data may need to be adjusted to represent the entire population. For instance, traffic counts taken only during part of a day can be factored up to reflect an all-day count. This effort requires sound data and judgment.

The use of maps and tabular displays illustrated in this chapter assists in locating points of congestion, accidents,



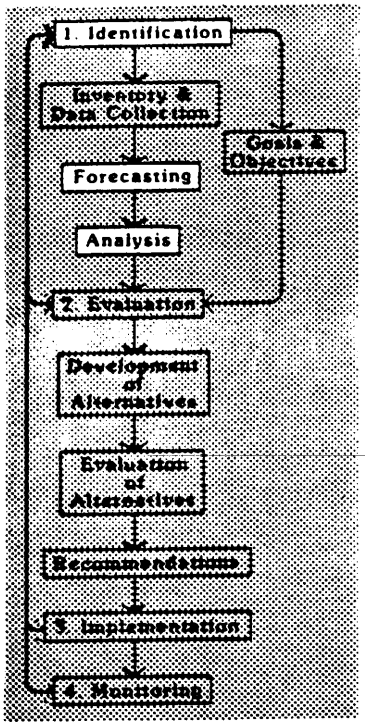
LAND USE ZONE	PRIMARY LAND USES	POPULATION	HOUSEHOLDS	EMPLOYMENT		
				MILITARY	CIVILIAN	TOTAL
1	AIRFIELD	0	0	10	0	10
2	RIFLE RANGE, LAKE	0	0	15	5	20
3	FAMILY HOUSING, GOLF COURSE, SCHOOL	1360	390	200	100	300
4	MOTOR POOL, SUPPLY, TRAINING	0	0	600	330	930
5	CIVIL ENGINEER, TENANT ADMINISTRATION	0	0	900	600	1500
6	FAMILY HOUSING, AIRCRAFT MAINTENANCE	350	100	200	300	500
7	FAMILY HOUSING, HOSPITAL	1580	450	150	350	500
8	CONTROL TOWER, BASE OPERATIONS	0	0	500	200	700
9	ADMINISTRATION, SCHOOL, CHAPEL, OFFICER'S CLUB, AIRMEN'S DORMITORIES	1910	40	2300	700	3000
10	COMMUNITY CENTER, DATA PROCESSING, BASE SECURITY	0	0	340	400	740
11	FLIGHT LINE, MAINTENANCE	0	0	1485	315	1800
TOTAL		5200	980	6700	3300	10000

Figure 2-7. Socioeconomic Characteristics

deficient parking, or other characteristics. For example, bar charts and other graphics can help the interpretation of traffic count data.

References 5 and 26 provides further examples of data summaries. Several microcomputer packages now produce report quality summaries, graphics, and bar charts for transportation data collection.

CHAPTER 3



DEFINING THE SITUATION: FORECASTING AND ANALYSIS

Transportation planning studies are made to identify both current and future needs. Therefore, examine not only the EXISTING problems and concerns, but also consider how the transportation system will need to change in the FUTURE.

This chapter provides assistance in IDENTIFICATION of current problems and opportunities, FORECASTING future conditions, and ANALYZING the situation. Upon completion of these steps, the planner will know the basic transportation deficiencies on the base and be able to find some short-term and long-term solutions.

Table 3-1 compares several typical situations on base with the types of forecasting and analyses tools that can be used. Page number references are also provided.

PROBLEM AND OPPORTUNITY IDENTIFICATION

Planning involves a process of identifying PROBLEMS and proposing SOLUTIONS. This is only part of the picture, however. Planning also requires innovative thinking to observe and make the best use of OPPORTUNITIES. Typical problems and opportunities are displayed in the attached table along with suggested forecasting and analysis techniques.

Transportation PROBLEMS arise due to many factors. Several problems relate to congestion on major roadways during peak hours, to lack of parking-at busy commissaries, BX's, or employment sites, and to inefficient land use placement.

Find Solutions to Problems

Take Advantage of Opportunities

Problems usually affect small groups or persons and not necessarily everyone on the base. Similarly, the problems which should be solved now are not necessarily those that exist now, but those that will exist at the time the solution will take effect. This time lag may be several years. Thus, DO NOT BE CONTENT WITH LOOKING AT TODAY'S

Consider Both Problems and Opportunities

Table 3-1. Forecasting and Analysis Tools for Analyzing Typical Problems and Opportunities

		Forecasts Needed?				Analysis Needed?		
		Trip Generation	Trip Distribution	Modal Split	Trip Assign-ment	Highway Capacity	Bus Studies	Other
TYPICAL PROBLEMS	Page	B-2	B-5	B-8	B-11	3-7	3-11	

	Forecasts Needed?				Analysis Needed?		
TYPICAL PROBLEMS Page	Trip Generation B-2	Trip Distribution B-5	Modal Split B-8	Trip Assign-ment B-11	Highway Capacity 3-7	Bus Studies 3-11	Other
Congestion - usually occurs at specific locations such as BX, commissary, or employment sites.	No	Y/N	No	Y/N	Yes	No	Speed, delay
New development - new or relocated land uses create new trips on base	Yes	Yes	Y/N	Yes	Yes	Y/N	Parking
High accident locations - locations with high accident rates or severity of accidents.	No	No	No	No	Yes	No	Accidents
Traffic through housing areas - heavy volumes and/or high speeds on local streets; resulting pedestrian accidents and noise.	No	Y/N	No	Y/N	Yes	Y/N	Speed delay
Poor accessibility to land uses - indicated by backups at parking lot entrances/exits, lack of parking spaces, and excessively long walking distances.	No	Y/N	No	Y/N	Yes	Y/N	Speed, delay, parking
Poor circulation - indicated by heavy turning movements and meandering travel paths. Misuse of a perimeter road can increase circulation problems.	No	Yes	No	Yes	Yes	No	Speed, delay
Backups at gates - caused by inefficient security techniques, insufficient number of gates, poor gate location, or lack of capacity.	No	Yes	Y/N	Yes	Yes	Y/N	Speed, delay
Lack of alternatives to the automobile - Lack of bus, carpooling, walking or bicycling facilities creates an overdependence on the auto, with resulting congestion.	Yes	Y/N	Yes	Yes	Yes	Yes	-
Visual intrusion - overuse or misplacement of signs and parking areas can give a "scattered debris" look.	No	No	No	No	No	No	Signing, parking
Inappropriate land development - plans for land development that run counter to transportation plans.	Yes	Yes	Y/N	Yes	Yes	Y/N	Parking

Table 3-1. Forecasting and Analysis Tools for
Analyzing Typical Problems and Opportunities (Cont'd)

TYPICAL PROBLEMS	Page	Forecasts Needed?				Analysis Needed?		
		Trip Generation	Trip Distribution	Modal Split	Trip Assign-ment	Highway Capacity	Bus Studies	Other
		B-2	B-5	B-8	B-11	3-7	3-11	
Use of abandoned runway or taxiway - may be useful as parking lots or new roadway alignments. However, dependence on runways or taxiways for new streets can create poor circulation.		Y/N	Yes	No	Yes	Yes	No	Speed, delay
Heavy concentrations of persons - at large employment and housing sites, concentrations of persons stimulate opportunities for bus and carpooling use.		Yes	Yes	Yes	Yes	Yes	Yes	Carpool-ing
Perimeter road - at several bases the existence of a perimeter road permits other transportation facilities and services to feed in a logical manner.		No	Yes	No	Yes	Yes	No	Accidents, speeds, delay
Other								

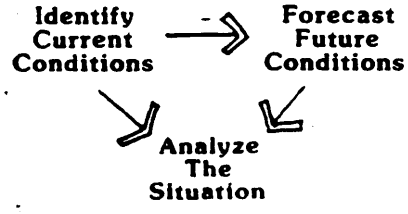
NOTE: Refer to Chapter 4 for alternative transportation actions.

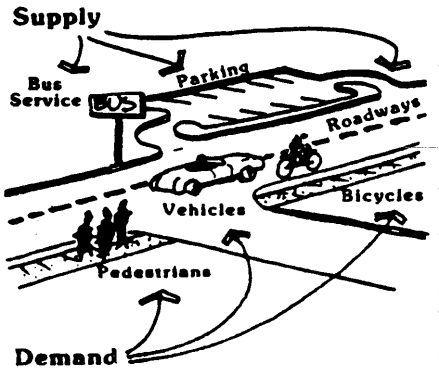
Yes = Usually needed
No = Not usually needed
Y/N = Possibly needed based on local circumstances

TRANSPORTATION PROBLEMS DUE TO:

- o INADEQUATE ROADWAY CAPACITY
- o INEFFICIENT USE OF AVAILABLE ROADS
- o LIMITED ACCESS TO AND FROM THE BASE
- o HEAVY TRAFFIC DEMANDS BY OFF-BASE PERSONNEL
- o LACK OF CLOSE-IN PARKING SPACES
- o LACK OF ALTERNATIVES TO THE AUTOMOBILE

- HIGH PROPORTIONS OF UNFAMILIAR DRIVERS.





PROBLEMS TO THE EXCLUSION OF POTENTIAL FUTURE PROBLEMS. That is where forecasting comes in.

The planner should also be aware of OPPORTUNITIES to lock on to some good features of the base. For example, the nearby community may be initiating a Carpooling rider matching program for area residents. This program in turn offers an "opportunity" for base personnel in forming carpools. This opportunity could reduce traffic growth on the base and therefore could influence plans for certain roadway improvements or parking facility expansions. Refer to chapter 4 for potential solutions to problems and actions which make the best use of opportunities.

Systematically identify transportation problems and opportunities on and off the base. Conduct FIELD INSPECTIONS to observe current conditions. The inspections should include visits to other base personnel involved in land use planning and to off-base planning personnel. Figure 3-1 provides an example of a highway and bus route checklist. Prepare a checklist ahead of time to aid in the field inspection.

TRAVEL FORECASTING

Good, sound planning requires good forecasts. Forecasting identifies the potential magnitude of change in some future year. TRAVEL FORECASTS are used to determine the transportation service need that will result from a change in land use.

Travel forecasting works with two interrelated aspects of the transportation system - SUPPLY and DEMAND. These are common economic terms used to describe the quantity and quality of services offered (SUPPLY) and the willingness and ability of users to purchase the services (DEMAND). Any change in the transportation supply can mean a change in demand, and vice-versa. Transportation planning must consider both supply and demand in order to

Route: _____ Prepared By: _____

Date: _____ Conditions: _____
(Weather, Road Maintenance, Other)

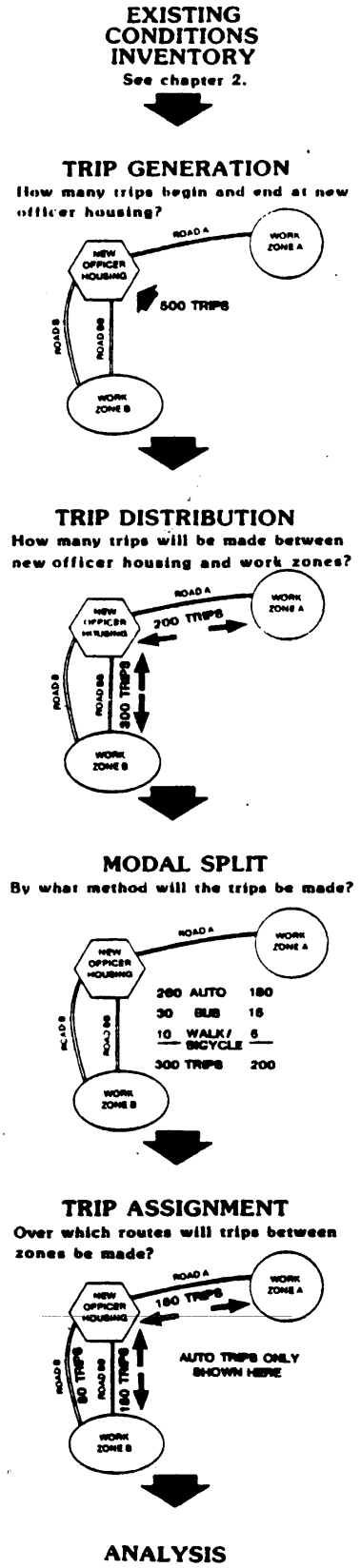
HIGHWAY FACILITIES

(Completed for sections of roadway, as appropriate)	Yes	No	If "Yes", Describe
a. Is the directional signing in need of improvement?			
b. Is traffic disrupted/slowed by on-street parking?			
c. Do left turns frequently hinder traffic flow?			
d. Is lack of traffic signal coordination an apparent problem?			
e. Are bicycle trails or lanes available?			
f. Are there frequent pedestrian-auto conflicts?			
g. Are there frequent intersections and/or driveways?			

BUS ROUTES

(Completed for each shuttle bus or community bus route, as appropriate)	Yes	No	If "Yes", Describe
a. Could the route be extended to serve major housing/activity concentrations?			
b. Could segments of the route be realigned to provide better service/increase speed?			
c. Does the route duplicate other routes?			
d. Is there a need for new or relocated bus stops along the route?			
e. Could the bus schedule be revised to better match duty hours?			

FIGURE 3-1. SAMPLE HIGHWAY AND BUS ROUTE CHECKLIST



balance the desire for travel with the ability of the transportation system to handle that demand. Since the supply of roads and other physical features is limited, pay close attention to ways of minimizing demand.

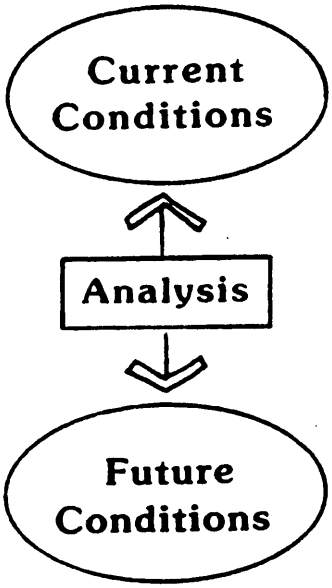
The FORECASTING PROCESS starts with the proposed road network and land use, :along with a thorough understanding of existing traffic flow patterns. used on this information, a prediction is made of the number of future trips to and from an activity (TRIP GENERATION), where these trips begin and end (TRIP DISTRIBUTION), by what method the persons are traveling (MODAL SPLIT), and over which routes the trips are to be made (TRIP ASSIGNMENT). Each of these steps is dependent on the availability of future LAND USE predictions, as described in the Land Use Planning Bulletin (Ref. l).

This forecasting process (see also Ref. 28, 45, and 49) is used to analyze various alternative transportation plans. After each analysis, all forecasts are examined to determine if they are reasonable. If the forecast is unreasonable, the assumptions and procedures used to predict the trips should be reexamined and appropriate changes made.

Forecasting can be done manually or with computers. For most on-base studies, use a manual method or a microcomputer forecasting package. More complex studies must rely on computer forecasting performed by outside consultants or by the regional planning agency in the surrounding community.

Accurate travel forecasting is a challenging task because of uncertainties in individual behavior. Mission changes imposed on a base by a MAJCOM can result in significant changes in travel characteristics. One advantage on an Air Force base, however, is that many travel patterns can be isolated since the base is largely self-contained, with well-defined entrance and exit points.

Refer to APPENDIX B for more details on the forecasting process.



ANALYSIS

Perform transportation analyses for EXISTING conditions and for FUTURE conditions. Current conditions will be evident from the results of the base inventory (chapter 2), and future conditions can be determined from the results of the forecasts described in this chapter. Two types of transportation analyses typically are done on a base--HIGHWAY CAPACITY and BUS STUDIES.

Highway Capacity Analysis

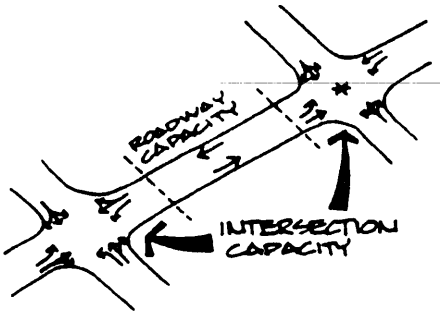
First, perform an analysis of highway conditions. This includes a detailed examination of traffic volumes and highway capacity. CAPACITY ANALYSIS is used to determine the ability of a roadway to handle the traffic that currently uses or is forecasted to use the facility. Highway capacity, very broadly, is the ability of a roadway to serve traffic.

The subject of highway capacity is complex and has been the focus of continuing study and research by traffic engineers. For many years the authoritative reference source has been the 1965 Highway Capacity Manual (Ref. 31). This document is now in the process of being updated. Interim Materials on Highway Capacity (Ref. 46) are now being used throughout the profession. MTMC Pamphlet No. 55-8 (Ref. 5) provides an overview of this topic for the base planner.

There are two general areas of concern: ROADWAY CAPACITY and INTERSECTION CAPACITY. Roadway capacity is often used for initial planning purposes since it is straightforward to calculate. However, in most cases the capacity is controlled by intersections, which are the locations where conflicting traffic movements take place.

HIGHWAY CAPACITY STUDIES

1. IDENTIFY POINTS OF CONGESTION
2. ESTABLISH PRIORITIES FOR TRANSPORTATION IMPROVEMENTS
3. DETERMINE DESIGN NEEDS FOR ROADWAYS



BASIC 24-HOUR ROADWAY CAPACITY

	NUMBER OF LANES 2	4
ROADWAY WITHOUT TURNING LANES (LEFT TURNS FROM TRAVEL LANE)	15,000	30,000
ROADWAY WITH TURNING LANES	20,000	36,000

ASSUMES:

24-HOUR TWO-WAY TRAFFIC VOLUMES

TYPICAL BASE ACCESS CONDITIONS TO ROADWAY (DRIVEWAYS, INTERSECTIONS)

PEAKING CHARACTERISTICS TYPICAL ON BASE

CAPACITY = LEVEL Of SERVICE E

FACTORS AFFECTING CAPACITY

Physical Features of the Roadway

- Number of lanes
- Lane width
- Lateral (side) clearance and width of shoulder
- Auxiliary lanes (parking, turning, bus stops)
- Surface conditions
- Alignment
- Grades

Traffic Conditions

- Percentage of trucks and buses
- Turning movements, particularly left turn
- Variations in traffic flow during peak hours
- Traffic interruptions, such as:
  - Traffic signals, military-police control, and STOP and YIELD signs
  - Volume of cross traffic at intersections
- Weaving and merging of traffic flows

Once the capacity is determined, compare it to the traffic volume on the roadway segment or intersection to determine the VOLUME-CAPACITY RATIO. The magnitude of the volume-capacity (v/c) ratio, then helps define the LEVEL OF SERVICE, which is an adopted set of alphabetical ratings. Six levels of service have been defined and designated by letters A (free flow) through F (forced flow and very unstable), as shown in Figure 3-2.

A highway will provide different levels of service depending on the volume and composition of traffic. The higher the traffic volume, the lower the level of service. Roadway level of service is also directly related to the amount of traffic delay which could be expected. The results of speed and delay studies during the travel characteristics inventory (Chapter 2) will enable the base planner to identify roadway locations with poor levels of service.

Intersection capacity seriously affects the ability of the base access roads to perform at maximum efficiency. While

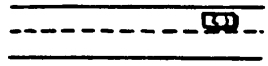
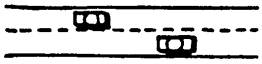
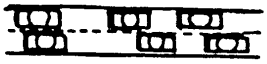
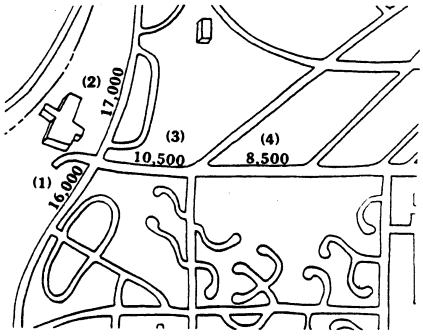
Level of Service		Description	Typical Base Examples
A		**Free flow.** Low volumes and no delays.	Off-peak hours on perimeter roads, near golf course etc.
B		**Stable flow.** Speeds restricted by travel conditions, minor delays.	Housing areas, most times; off peak hours in built-up area of base
C		**Stable flow.** Speeds and maneuverability closely controlled due to higher volumes.	Off peak gate conditons-peak hours near housing areas portions of perimeter road.
D		**Unstable flow.** Speeds considerably affected by change in operating conditions.	Typical peak period condition on perimeter road and adjacent to employment centers; frequently at gates, BX commissary
E		**Unstable flow.** Low speeds, considerable delay, volume at or near capacity.	Peak hour at main gate; major intersections with perimeter road leading from employment areas; near BX on Saturday afternoon; usually for short time period only
F		**Forced flow.** Very low speeds, volumes are <u>below</u> capacity, long delays.	Gate closures for security reasons; accident situations; back-ups on off-base roads force back-ups through gates

Figure 3-2. Volume/Capacity Relationships

LEVEL OF SERVICE	V/C RATIO[1]	DELAY RANGE (SECS. PER VEH.)[1]/
A	0.00-0.60	0.0-16.0
B	0.61-0.70	16.1-22.0
C	0.71-0.80	22.1-2&0
D	0.81-0.90	28.1-35.0
E	0.91-1.00	35.1-40.0
F	VARIES	40.1 OR GREATER

1/Source: Ref. 46

Forecasted Average Daily Traffic (24 Hour)



Roadway Point	(1)	(2)	(3)	(4)
Number of Lanes	2+Turn	2+Turn	2	2
Volume	16,000	17,000	10,500	8,500
Capacity	20,000	20,000	15,000	15,000
Volume/Capacity Ratio (V/C)	0.80	0.85	0.70	0.57
Level of Service	C	D	B	A

Note: Level of service at intersections may be different.

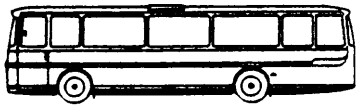
long range plans usually are developed using roadway segment capacity analysis, more detailed traffic planning studies must look closely at intersection conditions. Intersection capacity analysis typically is done using a process called CRITICAL MOVEMENT ANALYSIS, as described in Ref. 46. Step-by-step instructions are provided for general and detailed intersection studies.

The effects of BICYCLES and PEDESTRIANS on the highway system performance must also be measured. BICYCLISTS often are part of the traffic flow on base roads. Therefore, identify roadway locations where there are potential conflicts between bicyclists and motorists in heavy traffic volumes. Similarly, analyze any bicycle crosswalks for safety problems.

For PEDESTRIAN analyses, consider two factors - effects of pedestrian crossings on traffic flow and safety, and the capacity of sidewalks to handle pedestrian demand. The Interim Materials on Highway Capacity (Ref. 46) provide specific guidance in performing these studies. For most base planning applications, sidewalk capacity will not be a major factor. However, there is a continuing need to improve the ability of pedestrians to move among base land uses in a safe manner, without disrupting traffic flow.

Bus Studies

BUS STUDIES



- COORDINATE WITH OFF-BASE TRANSIT AGENCY
- ISOLATE CURRENT AND FUTURE TRAVEL PATTERNS
- PINPOINT LOCATIONS OF DELAY AND INEFFICIENT ROUTINGS
- IDENTIFY LOADING POINTS AND BOARDING/ALIGHTING LOCATIONS

Bus studies are necessary to determine the ability of existing or proposed bus services to meet current or future demand. Several factors must be considered - bus capacity, travel time, routes, and schedules. For the most part, the planner will be concerned with the operation of an on-base shuttle bus. However, in cases where bus service is provided to/from the base by the local transit agency, the planner should cooperate on bus studies performed by the agency.

Determine existing shuttle bus adequacy by examining the results of the bus inventory and origin/destination surveys (see Chapter 2). The bus inventory will show the planner where the highest and lowest load points are on the base and the locations where most persons board and alight. Use this information to determine where there are overcrowded (or undercrowded) locations along the bus route during different time periods.

Also use the results of an on-board origin/destination survey to determine the travel patterns of bus users. Together with basewide origin/destination survey results, this information will assist in identifying current route and/or schedule problems as well as opportunities for new or revised shuttle bus service. Bases without existing shuttle buses can use origin/destination survey results to determine the feasibility of starting a shuttle bus. Important

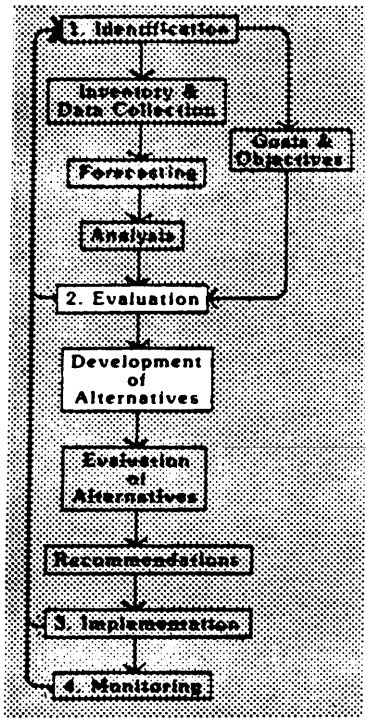
information includes the bus person demand, bus seating capacity, expected frequency (i.e., HEADWAY) of service, and round trip bus travel time. These data permit a calculation of bus vehicle needs.

EXAMPLE OF BUS NEEDS

- Estimated bus person demand.
  - Peak hours (0600 - 0800, 1600 - 1800) = 400 persons/peak period = 100 persons/hour
  - Off peak hours (0800 - 1600) 320 persons = 40 persons/hour
- Bus seating capacity = 35
- Frequency of Service = every half hour between 0600 and 1800 = 12 hours
- Roundtrip bus travel time = 40 minutes
- Bus vehicle needs:
  - Basic half hour service will require 2 buses, each with 20 minutes wait between trips.
  - Total Trips 2 trips/hour *12 hours 24 trip%.
  - Capacity = 35 seats/bus * 2 bus/hr = 70 seats/hr
  - Compare capacity to hourly person demand
    - -- Adequate for off peak hours
    - -- Inadequate for peak hours
  - Need to add 3rd bus for 0600 - 0800 and 1600 - 1800
    - -- Therefore, capacity = 35 seats/bus * 3 bus/hour = 105 seats/hour (This is OK to meet peak demand)

* 3 buses needed to meet demand. Desirable to have an extra bus for spare. Total = 4 buses

CHAPTER 4



MEETING THE NEEDS - ALTERNATIVE PLAN DEVELOPMENT

The planner has reached the stage in the planning process where the current and future transportation needs of the base are evident. The next step is to examine appropriate ways to meet these needs. Except in rare cases where only one action is possible, the planner must define different alternative actions. This requires both creativity and the ability to evaluate proposed ideas at an early stage, so that major effort is not wasted on completely unrealistic alternatives. The selected alternatives then become the focus of the plan evaluation, as discussed in Chapter 5.

LAND USE AND TRANSPORTATION

Alternative land use and transportation plans must be developed concurrently. Each possible land use alternative may suggest one or more transportation system, which, in

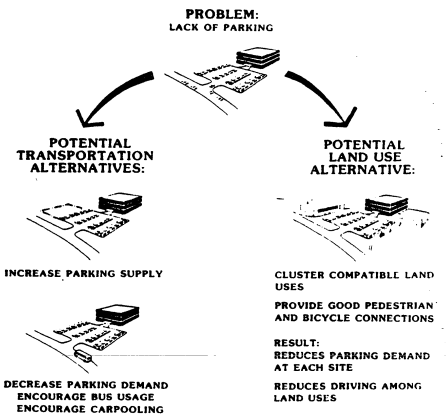
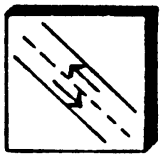
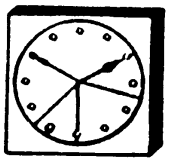
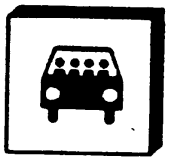


FIGURE 4-1
POTENTIAL TRANSPORTATION ALTERNATIVES
ON AIR FORCE BASES

CATEGORY	STRATEGY	ALTERNATIVE
Streets and Highways	Change Locations	• Roadway or gate relocation
	Change Geometry	• New roadways or gates
		• Intersection, roadway, and gate widening (including turn lane installation)
Page 4-6		• Physical traffic diverters and speed controls
		• Limit curb cuts
	Change Operations	• Turning movement restrictions
		• One-way streets
		• Reversible lanes
		• Traffic signal installation/ removal
		• Traffic signal timing
		• Bus or carpool lanes
		• Passive traffic diverters and speed controls
		• Auto restricted zones
		• Revised gate security
		• Modified measures movements of hazardous materials
Bus Services and Facilities	Change Operation	• Bus route and schedule modifications
		• On-base shuttle bus
Page 4-19		

CATEGORY	STRATEGY	ALTERNATIVE
		• Off-base local or express bus
		• Bus stop revisions
	Change Management	• Marketing Programs
		• Maintenance improvements
		• Bus vehicle improvements
Parking	Change Parking SUPPLY	• New parking lots
		• Increase parking spaces
		• Restripe lots for more spaces
	Change Parking DEMAND (Parking Management)	• Parking restrictions (on-street, off-street)
Page 4-22		• Priority spaces for carpools
		• Shared parking
Pedestrian and Bicycles	Change Accessibility	• Pedestrian crosswalks and signalization
 		• Pedestrian walkways
		• Bikeways
		• Bicycle parking facilities
Page 4-25		
Alternative Work Scheduling	Spread Out Peak Hours	• Flex-time
		• Staggered work hours
		• Compressed work week
Page 4-28		
Ridesharing	Promote Carpools and Vanpools	• Carpool matching
		• Vanpool program
Page 4-30		

turn, will lead to a re-examination of the proposed land use concept. These land uses may then result in a need to revise the future travel forecasts (see Chapter 3), and so forth. In practice the planner must decide on a reasonable blend of land use and transportation alternatives.

TRANSPORTATION ALTERNATIVES

The term TRANSPORTATION ALTERNATIVE refers to a combination of actions which may involve traffic control, roadway changes, bus operations, parking, pedestrian and bicycle facilities, carpooling techniques, and special on-base actions relating to base access and security, movements of hazardous materials, and other specific needs. IT IS NOT ENOUGH TO MERELY LOOK AT ONE ALTERNATIVE IF THERE ARE OTHERS WHICH COULD PROVIDE EQUAL OR BETTER TRANSPORTATION SERVICE

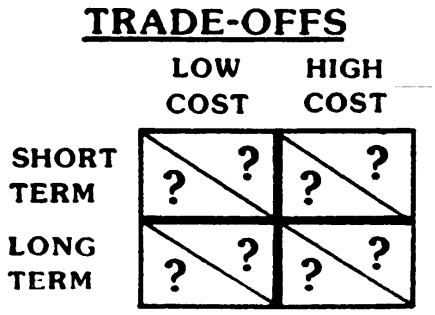
Figure 4-1 gives several typical examples of transportation alternatives on Air Force bases. These alternatives are more fully described later in this chapter.

Transportation alternatives can be categorized according to time and Cost requirements. Generally, short-term actions to meet current needs would be lower Cost, while major changes requiring more time to implement would tend to Cost more. Since most bases already have established transportation systems, the need for planning changes several years into the future will be the exception rather than the rule. Short term and/or lower-cost alternatives will fit many of the base needs, as long as they are consistent with the base's longer term development objectives.

THEREFORE, PLACE THE EMPHASIS ON IMPROVING THE USE OF EXISTING FACILITIES AS OPPOSED TO EMPHASIZING TOTALLY NEW SYSTEMS Early in the planning process select the most feasible transportation alternatives from among a range of alternatives. In this way, attention can be focused on the most applicable alternatives.

TRANSPORTATION ALTERNATIVES

- STREETS AND HIGHWAYS
- BUS SERVICES AND FACILITIES
- PARKING MANAGEMENT
- PEDESTRIAN FACILITIES
- BICYCLE FACILITIES
- ALTERNATIVE WORK SCHEDULING
- RIDESHARING



Select Potential Alternatives

The potential list of alternatives should cover a wide variety of actions. At this stage of the process, it is only necessary to identify potential alternatives in general terms to make sure that none are forgotten. Make an initial judgment as to how well a particular alternative meets the base goals and objectives. If it is incompatible, an alternative should not be considered further. Refer to Figure 4-2 to identify types of alternatives to consider for typical Air Force problems and opportunities.

The alternatives may range from major roadway construction to minor adjustments in the schedule of a shuttle bus. However, given the current status of bases, most alternatives will involve changes to existing facilities and services rather than actions requiring major restructuring of the base. These alternatives are known as TRANSPORTATION SYSTEMS MANAGEMENT (TSM) actions. TSM alternatives often match the typical needs on the base and allow the planner to take advantage of good opportunities that may already exist. Contact the local planning agency for more information on TSM actions being considered on a regionwide level.

TRANSPORTATION SYSTEMS MANAGEMENT (TSM)

- o SHORT TO MEDIUM -ME FRAME
- o LOW TO MODERATE COST
- o CONSIDERS VARIOUS MODES
- o MEETS COMMON NEEDS ON BASE
  - REDUCE CONGESTION
  - IMPROVE PARKING CONDITION
  - ENCOURAGE NON-AUTO MODES

Identify Alternatives to Meet Specific Needs

Examine the list of alternatives relative to the current and future needs on the base. Although the number of potential alternatives on the list may be large, there are likely to be no more than three or four which are responsive to the identified needs (See Figure 4-2). At all times, make sure that the selected alternatives coincide with the base goals and objectives (see Chapter 2).

Once the alternatives have been identified, prepare a PROJECT DESCRIPTION consisting of the following items:

- Description of need - characteristics, problem
- Location of need (preferably show on a map)

EXAMPLE PROJECT DESCRIPTION

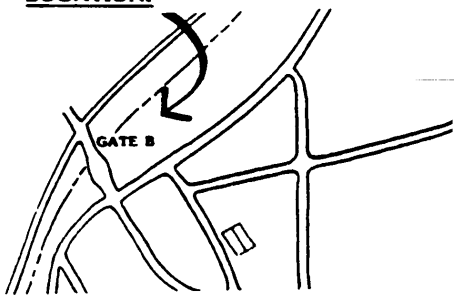
CHARACTERISTICS:

- GATE B ON ANYTOWN AFB
- HEAVY TRAFFIC VOLUMES BETWEEEN BASE AND OFF-BASE ROADS

PROBLEM:

- TRAFFIC DEMAND EXCEEDS CAPACITY DURING PEAK HOUR, CAUSING BACKUPS

LOCATION:



EXAMPLE PROJECT DESCRIPTION

OBJECTIVES:

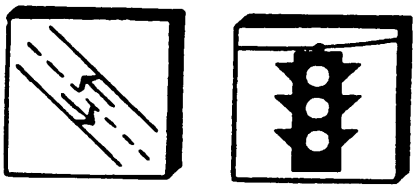
- IMPROVE TRAFFIC LEVEL OF SERVICE DURING PEAK HOUR
- REDUCE BACKUPS ON GATE B APPROACH ROADS

ALTERNATIVES:

- WIDEN GATE APPROACH ROADS
- ADD ADDITIONAL GATE NEARBY
- CREATE STAGGERED/FLEXIBLE WORK HOURS
- PROMOTE RIDESHARING AND BUS USE

DATA REQUIRED:

- AUTO OCCUPANCIES
- ROADWAY GEOMETRICS
- TRAFFIC VOLUMES
- DELAY
- LENGTH OF BACKUPS
- BUS ROUTES, SCHEDULES



-

- Applicable objectives to be met
- Potential alternatives
- Data requirements

The advantage of writing down this description is to determine if the alternatives really look feasible or should be dropped from consideration. Keep in mind that the alternatives that pass this review will be included in the detailed evaluation (see Chapter 5). Depending upon the needs, different alternatives may be necessary for short term or long term plans.

The remainder of this chapter includes brief descriptions of alternatives which are typically applicable on an Air Force base. Use this information to help determine with alternatives specific to the needs of the base.

STREETS AND HIGHWAYS

Alternatives relating to the design and operation of streets and highways are applicable on all air bases. This section will focus on alternatives which affect access and circulation on the base. Specific traffic engineering and design guidance is provided in MTMC Pamphlets 55-10 (Ref. 7), 55-14 (Ref. 9), 55-15 (Ref. 10) and 55-16 (Ref. 11).

PLAN STREETS AND HIGHWAYS TO MEET THE ACCESS NEEDS OF THE LAND USES BEING SERVED. These access needs can vary significantly. For example, community centers serve many off-base and on-base persons. Therefore, plan the surrounding street system to provide direct access to gates and to various on-base housing and employment areas. Other land uses with similar access needs include the hospital/medical complex, clubs and dining areas, and recreation facilities.

Land uses predominantly used by on-base personnel should be served by streets which provide good access to compatible on-base activities. For example, the housing office, dependent schools, and chapel should have good

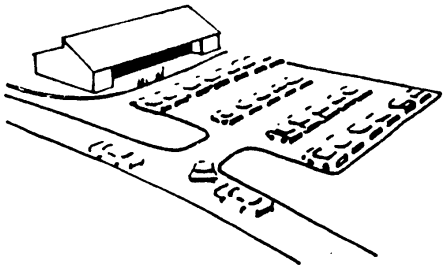
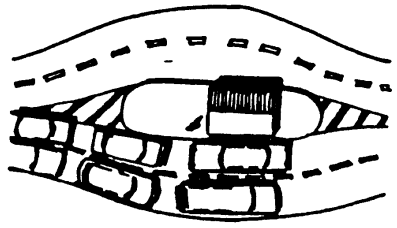
TYPICAL PROBLEMS/OPPORTUNITIES	PROBABLE CAUSES	POTENTIAL ALTERNATIVES
Congestion Adjacent to BX or Commisary 	Heavy Volumes In/Out of Parking Lots	. CONSTRUCT or RELOCATE ROADS in vicinty to improve access
	Poor Access Roads Create Poor Circulation	. WIDEN ROADWAY or INTERSECTIONS
	Inefficient Placement Relative to Other Community Services	. Install or improve TRAFFIC CONTROL DEVICES (E.G., TRAFFIC SIGNAL)
		. Improve SHUTTLE bus ROUTES or SCHEDULES adjacent to site
		. Create better PEDESTRIAN WALKWAYS to adjacent services
Congestion At Gates 	Heavy Volumes To/From Base	. RELOCATE GATE
		. Add NEW GATE(S)
	Inadequate Approach Road Capacity	. Widen gate APPROACH ROADS
	Inefficient Security Procedures	. Create REVERSIBLE LANES
	Poor Gate Location	. Revise SECURITY PROCEDURES
		. Promote RIDESHARING and BUS USE
		. Make BUS ROUTE and SCHEDULE revisions or add NEW bus routes
		. Introduce ALTERNATIVE work schedules

FIGURE 4-2
EXAMPLES OF ALTERNATIVES DEVELOPMENT

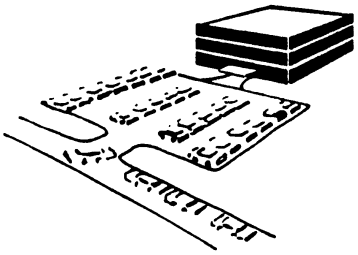
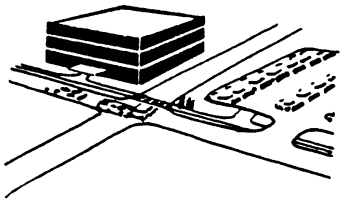
TYPICAL PROBLEMS/OPPORTUNITIES	PROBLABLE CAUSES	POTENTIAL ALTERNATIVES
Inadequate Parking At Majcom Administrative Building. Long Walking Distances For Many Employees 	Inadequate Provision of Spaces Few Alternatives to Auto Access Poor Placement of Building Relative Poor Placement of Building Relative To Other Land Uses	. Add MORE PARKING SPACES or build NEW PARKING LOT . Designate PRIORITY SPACES for CARPOOLS . SHARE PARKING with adjacent land uses. . Designate better PEDESTRIAN/BICYCLE ROUTES (sidewalks, bike lanes, etc.) for access . Install BICYCLES STORAGE FACILITIES . Promote RIDESHARING and BUS USE . Make bus ROUTE and schedule REVISIONS, or add NEW bus routes
High Vehicle and Pedestrian Accident Rate at Busy Intersection. High Pedestrian Volumes Cross From Parking Lot To Employment Sites 	Poor Physical Design of Intersection Inefficient Land Use and Parking Placements Create High Pedestrian Volumes Across Intersection	. Improve intersection GEOMETRICS . Improve TRAFFIC CONTROL devices at intersection (e.g., traffic signal, stop sign, yield sign) . Provide PEDESTRIAN OVER-OR UNDER-CROSSING . Revise LAND USE or PARKING PLACEMENT TO minimize pedestrian crossings

FIGURE 4-2
EXAMPLES OF ALTERNATIVES DEVELOPMENT (CONT'D)

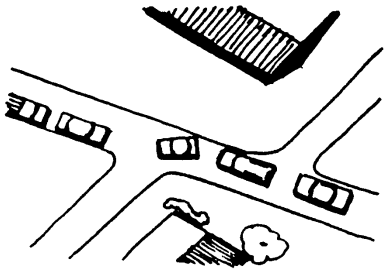
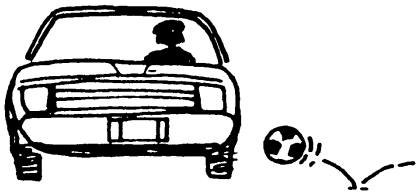
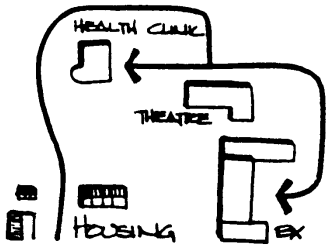
TYPICAL PROBLEMS/OPPORTUNITIES	PROBABLE CAUSES	POTENTIAL ALTERNATIVES
Congestion and Frequent Turning Accidents On Perimeter or Major Through Road 	Too Many Inter-Driveways Abutting road Inefficient Land Use Placement Cause High Traffic Volumes Poor Location or Inadequate Number of Gates Cause Higher Volumes Through Base	• REDUCE NUMBER OF ACCESS POINTS to perimeter road • RELOCATE Perimeter road • WIDEN perimeter ROAD • Install TURNING LANES • Improve TRAFFIC CONTROL DEVICES • RELOCATE or BUILD new GATES • Revise LAND USE PLAN
High Volume, Speeds, and Pedestrian Accidents in Housing Areas 	Too Much Through on Local Streets Ineffective Speed Controls Poor Pedestrian Facilities	• Implement TRAFFIC CHANNELIZATION techniques • Improve Traffic CONTROL DEVICES • Improve SIDEWALKS and PEDESTRIAN WALKWAYS away from streets • BUILD or RELOCATE ROADS to handle through traffic
Circuitous Travel Required Form Housing Area To Scattered Community Services 	Inefficient Roadway Locations Inefficient Locations of Community Services	• CONSOLIDATE SERVICES INTO COMMUNITY CENTER convenient to housing areas • RELOCATE ROADWAY to provide direct traffic movements • Revise BUS ROUTES and SCHEDULES

FIGURE 4-2
EXAMPLES OF ALTERNATIVES DEVELOPMENT (CONT'D)

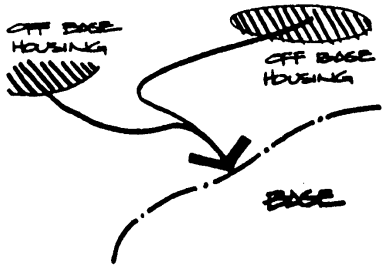
TYPICAL PROBLEMS/OPPORTUNITIES	PROBABLE CAUSES	POTENTIAL ALTERNATIVES
• Heavy Concentration of Base Employees Live Off-base In Specific Communities 	Lack of On-base Housing Causes Movement To Off-base	• Institute CARPOOL/ VANPOOL MATCHING (through regional ridesharing effort) • Improve travel route(s) with cooperation of state and local agencies

FIGURE 4-2
EXAMPLES OF ALTERNATIVES DEVELOPMENT (CONT'D)

highway access to on-base housing. Locate these land uses and plan adjacent streets accordingly.

Streets and highway alternatives usually are distinguished by one or more of the following: LOCATIONAL changes, GEOMETRIC changes, and OPERATIONAL changes. Special consideration is given to housing areas, for which specific actions apply.

Locational changes

The purpose of road location is to position a road within a strip of land (i.e., right-of-way) in such a way that it will satisfy traffic demands as well as safety and environmental considerations. The alternative locations of new or revised streets vary depending on the locations of existing or planned land uses, the topography of the base, and the locations of gates or other transportation focal points. MTMC Pamphlet 5-10 (Ref. 7) describes road location in greater detail.

STREET LAY0UT OBJECTIVES

- o CONCENTRATE TRAFFIC ON ARTERIALS.
- o LOCATE ARTERIALS TO SERVE BUILT-UP AREA.
- o SUPPLY ADEQUATE NUMBER OF COLLECTOR AND LOCAL STREETS
- o PROVIDE DIRECT TRAVEL ROUTES
- o ENSURE COMPATIBLE LAND USES

For planning on new or expanding bases, examine various roadway location alternatives together with the various land uses which are being planned. Figure 4-3 provides some examples. On existing bases with established land uses and street system, typical actions consist of short segments of new road to provide better access to certain land uses or to provide better internal traffic movements. Location of gates is discussed later in this chapter.

Many bases evolved in a haphazard manner, using the remnants of old runways/taxiways and temporary barracks areas as the basis for a street system. This occurred at Anytown AFB, as shown in Figure 4-4. The result is inefficient traffic movements, which can be minimized through good planning.

One of the problems encountered most frequently is the arbitrary placement of new buildings. Coordinate the land use and transportation portions of the BCP to ensure that new buildings do not interfere with the planned street system.

Source: Ref. 6

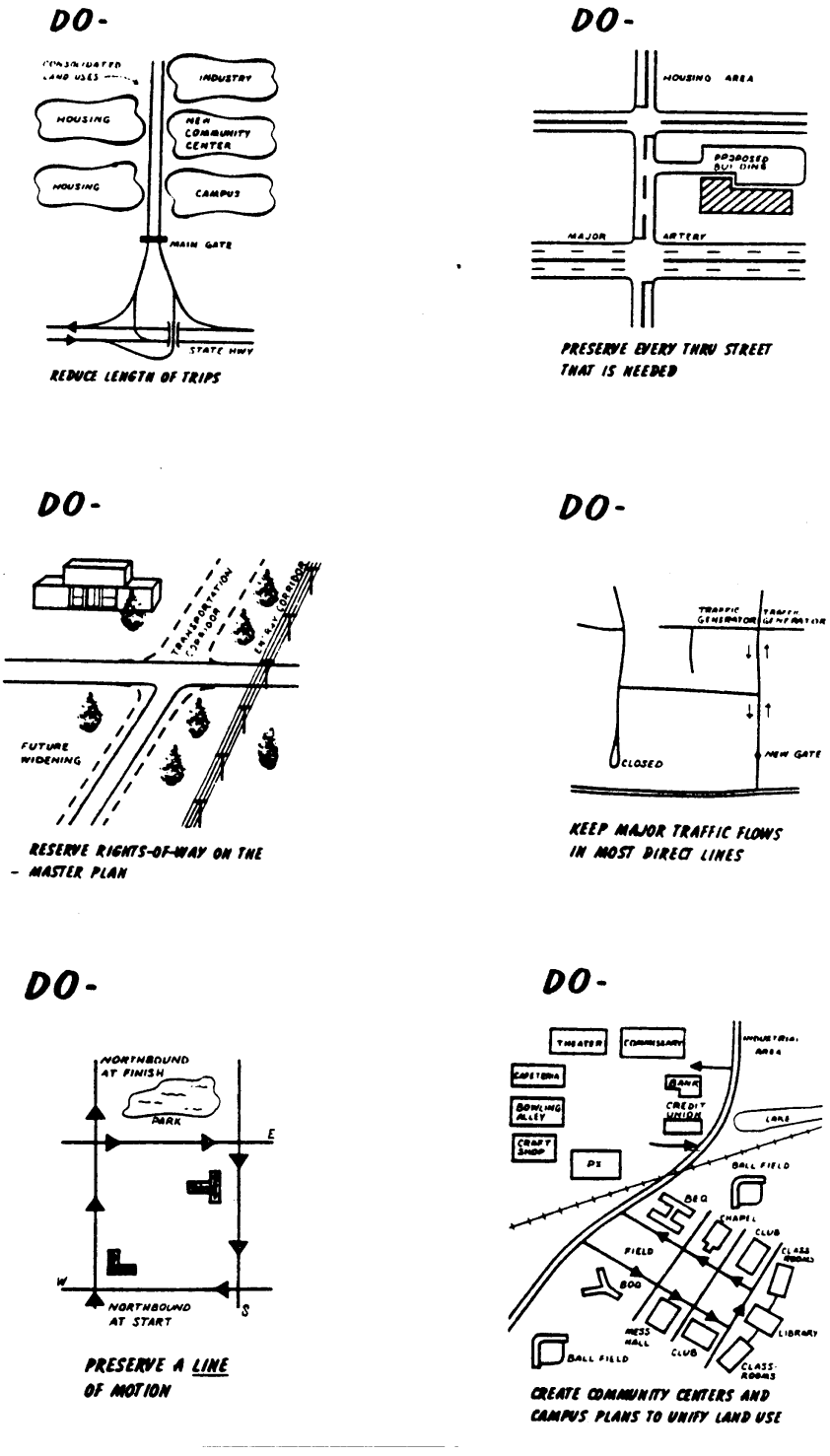


Figure 4–3. Streets and Highway Locational Guides

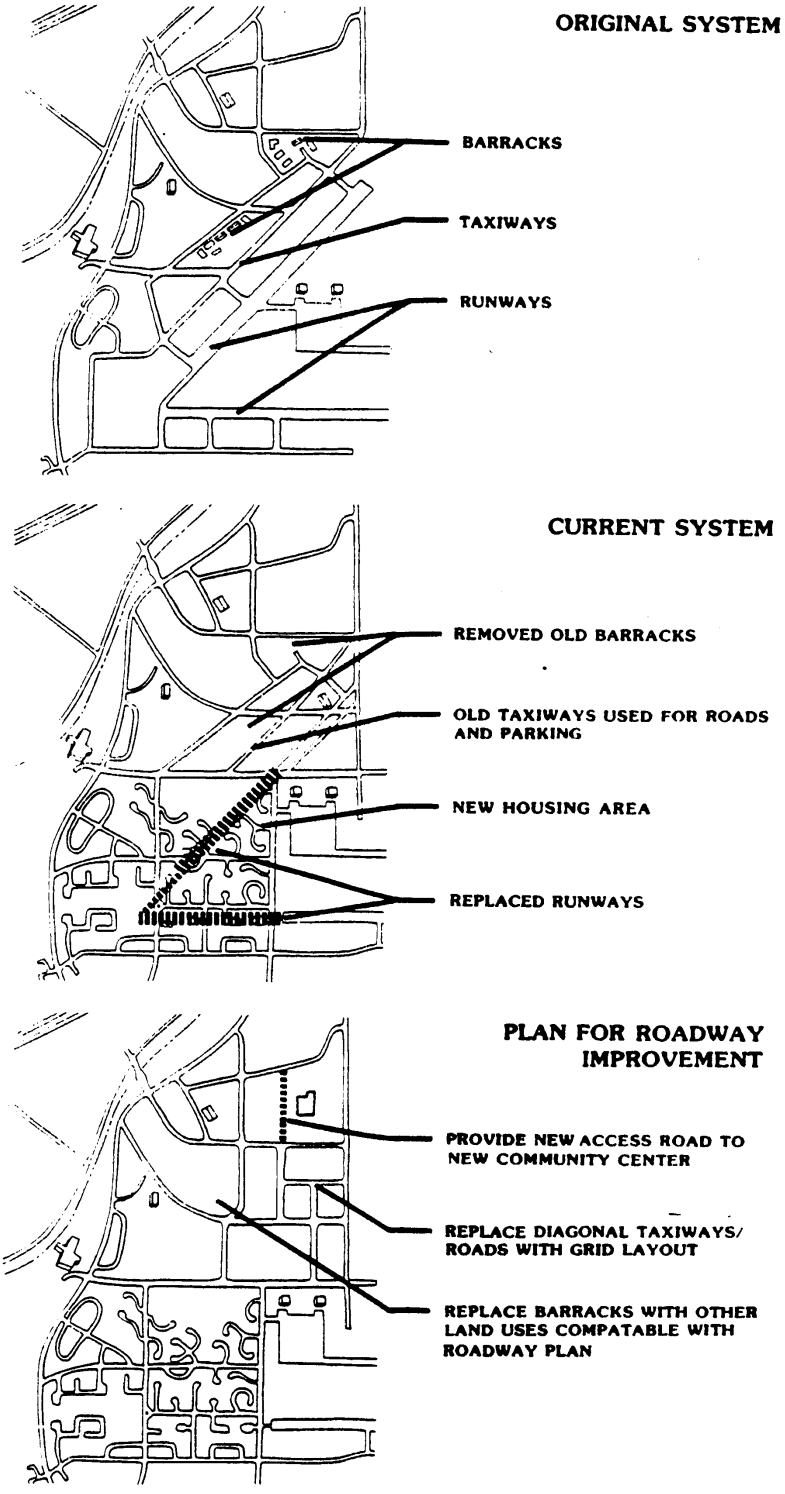
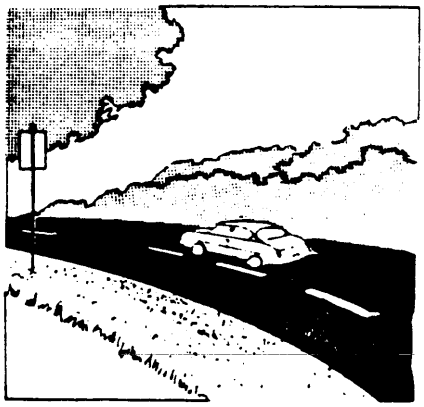


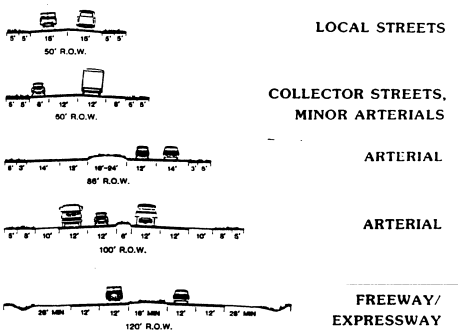
Figure 4-4. Evolution of Anytown AFB Road Network

Geometric Changes



GEOMETRIC CHANGES

- NEW STREET DESIGN
- WIDEN EXISTING INTERSECTION AND ROADWAYS



The efficient movement of traffic volumes on the base is directly related to the design of the roadways. Although detailed geometric design is not a direct function of the planning process, it is important to understand the types of geometric changes which could be considered.

Design Of New Streets - As discussed under locational changes, there may be a need to consider new streets in the planning process. In developing alternatives, the planner should understand enough about geometric design to determine whether the action is feasible. Geometric design of new facilities is specifically described in MTMC Pamphlet 5-1O (Ref. 7). Gate design is discussed later in this chapter.

Right-of-way requirements are probably the most important. Depending on the roadway functional classification (see Chapter 2), there will be different right-of-way requirements,

TYPES OF WIDENING

- WIDEN STREET FROM TWO TO FOUR LANES
- ADD LEFT TURNING LANES ALONG PERIMETER ROAD
- ADD LEFT OR RIGHT TURNING LANES AT INTERSECTIONS
- INCREASE TURNING RADII AT INTERSECTIONS WITH HEAVY TRUCK TRAFFIC

On new streets to ensure that safe and efficient traffic movements and land use access are achieved. For instance, plan a designated large truck route along streets with geometrics intended for handling large design vehicles. Similarly serve truck loading activities with collector or local industrial streets and keep them away from arterial streets carrying through traffic.

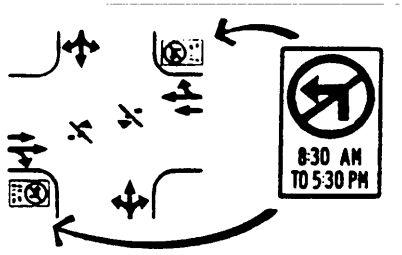
Other design considerations for new streets include geometric continuity from one street to another, intersection channelization, and horizontal/vertical clearances. These topics are covered fully in the report Design of Urban Streets (Ref. 41).

Intersection and Roadway Widening - This action includes all short-range, low cost roadway construction and reconstruction projects whose primary intent is to improve capacity and quality of flow for all vehicular traffic. In many instances, an additional lane can be obtained through restriping the existing roadway without needing new construction.

Operational Changes

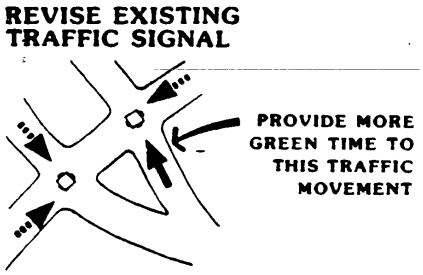
Operational changes on streets and highways cover a wide range of actions aimed at improving vehicular- and person-traffic flow and improving safety. Some operational changes can be accomplished without any physical roadway change, while others will require redesign of some or all of a roadway or intersection. Typical actions include:

Turning Movement Restrictions - Prohibiting certain turning movements at high volume or high accident intersections can be accomplished with signs and pavement markings. Prohibit turns at all times or during peak traffic hours (e.g., 0700-0900, 1600-1800). Make sure that there are alternative routes available for the restricted traffic.



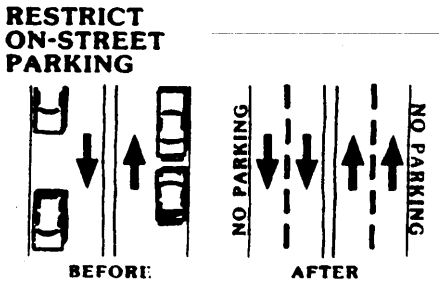
One-Way Streets - This action includes all traffic control actions (signing and marking) and physical construction necessary to change one or more existing two-way roadways into a one-way street system. Typically, parallel two-way streets are converted into opposing direction one-way streets.

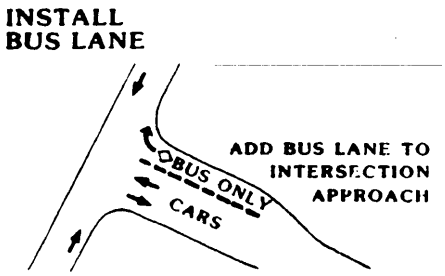
Reversible Lanes - This action reverses a lane of traffic to favor the predominant direction of flow for a given time period. It is used during peak hours when there is a heavy volume of traffic in one direction. During other time periods, the reversible lane could be used for left turns.



Traffic Signal Revisions - There is a wide variety of actions which modify and improve the performance of traffic signals. Local intersection signal improvements include signal retiming, rephasing, or equipment changes, as well as the basic installation or removal of a signal. Warrants for installing a traffic signal are given in the Manual on Uniform Traffic Control Devices (Ref. 47). Signals along arterials can be interconnected to improve traffic flow. Interconnection of traffic signals is generally not effective in cases where the signals are spaced at intervals of greater than 1/2 mile. Contact the traffic engineer in the adjacent community for more information on traffic signal operations.

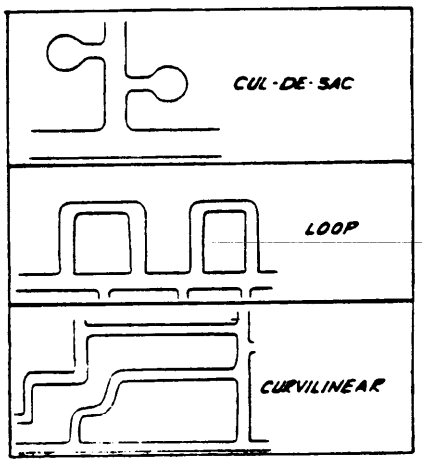
On-Street Parking Restrictions - This action seeks to improve traffic flow by removing parked vehicles along a roadway during all or part of a day. More information on this action is given in the "Parking" section of this chapter.





Bus or Carpool Lanes - The typical application of this action is to reserve a roadway lane for the exclusive or prioritized use of buses. Some projects also have included carpools, taxis and other special vehicles. The action can be applied by taking a lane away from existing traffic, or by adding a lane either through roadway reconstruction, restriping, removal of parking, or with a reversible lane. Priority lanes are not applicable on many bases except where there is a large bus or car pool volume. The strategy is applied for short segments such as at gates or intersection approaches where backups regularly occur.

Traffic Control in Housing Areas



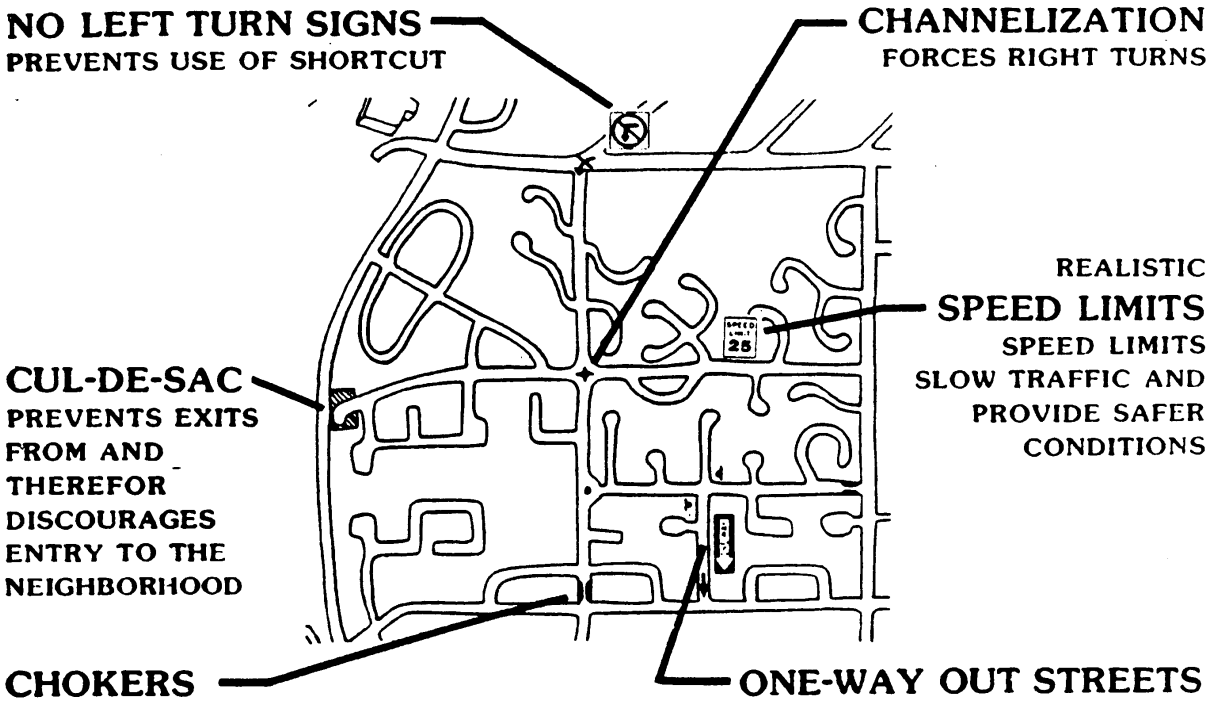
Concerns for safety and quality of life in housing areas have created a need to consider special transportation actions aimed at improving these conditions. The concept of Planned Unit Development (PUD) can be used to design streets to maximize accessibility to residents but to discourage trips through the housing area. In a PUD the land uses and street patterns are jointly planned. Through the use of closed-end, loop, or curvilinear streets, the traffic on residential streets is greatly reduced because the streets have no value for non-residents.

In established housing areas, however, protection must be through retroactive methods. Techniques range from PHYSICAL controls, which actually change the street configuration, to PASSIVE controls, which induce drivers to act in a desired fashion as a result of perceptual reactions. Since passive controls do not involve physical changes, they can be in force during only part of the day, if desired. Keep in mind that any traffic controls will affect residents, as well as the through traffic.

A complete discussion of traffic control alternatives is presented in Ref. 42. The following list includes many techniques which could be applied to an air base. An example on Anytown AFB shows how some elements can be put together into a plan in a housing area.

PHYSICAL CONTROLS

- Channelization - (also called diverters) - Physical barriers placed in the street to force vehicles to turn in a particular direction. The purpose is to make through traffic difficult without actually preventing it.
- Choker - The narrowing of a street in order to reduce the width of the traveled way, thus discouraging through traffic and providing wider sidewalk areas.



- Woonerf - A Dutch term for a design in which housing streets are converted into pedestrian-dominated "residential yards" (i.e., woonerf). The streets are broken up in their length with narrow paths, trees, parking areas, and planters. Sidewalks and curbs are eliminated. Thus, automobile and pedestrian access for residents is maintained, while through traffic is eliminated.

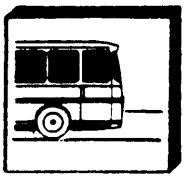
- Cul-de-Sac - A street ending with a loop or turnaround, forcing all traffic to return or remain. Existing streets can be barricaded at an intersection or midblock, leaving the block open to local traffic at one end, but physically barring the other end.

PASSIVE CONTROLS

- Stop Signs - Regulatory devices used to assign right-of-way at intersections. Studies have shown that stop signs have little effectiveness in speed and volume control. Therefore, use good judgment in housing areas.
- Speed Limit Signs - Regulatory devices intended to inform motorists of a speed limit. Lower speed limits are intended to produce lower volumes and safer speeds. However, artificially low speed limits (i.e., less than 20 mph) are poor designs.
- Turn Prohibition Signs - Regulatory devices used to restrict turns onto local streets. These are typically applied at the periphery of the neighborhood, often during peak traffic hours.
- One-Way Streets - Use of various combinations of one-way street regulations to discourage movements through the housing area. One-way streets can also be used along adjacent collector or arterial streets, to increase capacity there and reduce the desire to use residential streets for through trips.
- Other - Other passive controls include use of traffic signals, yield signs, school zones, "slow" signs, truck restrictions, and parking controls. In all cases, the objective is to discourage or slow down traffic in housing areas.

BUS SERVICES AND FACILITIES

Bus services on an Air Force base are typically one of two kinds:



- Shuttle Bus - This is regular bus service within the base connecting various employment, housing, and commercial areas. Shuttle buses may also run between the base and another base in the same geographic area.

- Public Transit - Local transit agencies may run public bus service to/from the base. This service, operating on a fixed-bus route, provides transportation between on-base and off-base activities. Two types of service are prevalent -- LOCAL bus, making frequent stops, and EXPRESS bus, making stops between the base and a specified off-base housing area, downtown area, or parking lot.

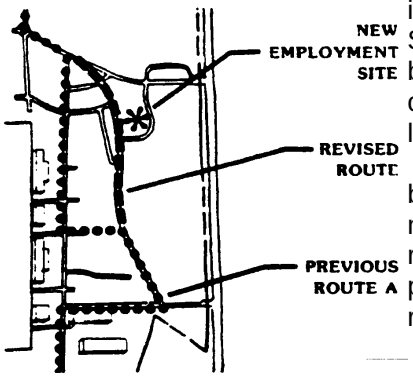
For planning purposes, it is possible to consider changes in shuttle bus OPERATIONS and MANAGEMENT. Work directly with the local transit agency to propose any changes in public transit serving the base.

Bus Operational Changes

Bus operational changes primarily affect the hours of operation, frequency of service, and locations of service.

Route and Schedule Modifications - These changes can be implemented rapidly and can produce significant improvements. A SHUTTLE BUS route is easily changed to serve new or relocated buildings or housing areas. Similarly, the schedule, or times, of operation can be modified to match duty hours or to provide earlier or later service.

PUBLIC TRANSIT routes within the base are determined jointly between the base officials and the local transit agency. A request for a new routing on-base will usually be agreeable unless the routing will result in additional time or mileage for the bus. Schedule changes are possible, but must be coordinated with schedule needs for the remainder of the bus route off the base.

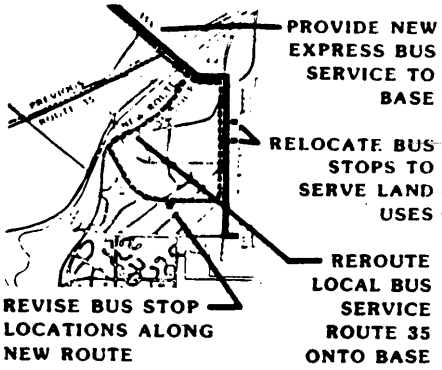


MODIFY SHUTTLE BUS ROUTE A TO MEET NEW DEMANDS

CHANGE HOURS OF OPERATION

	PREVIOUS	REVISED
WEEKDAY	0600-1800	0600-2000
WEEKEND	1000-1800	0900-1800

When bus schedules are relatively fixed, base planners may want to consider modifying base duty hours as an alternative. An upcoming section labeled "alternative work schedules" addresses this issue more completely.



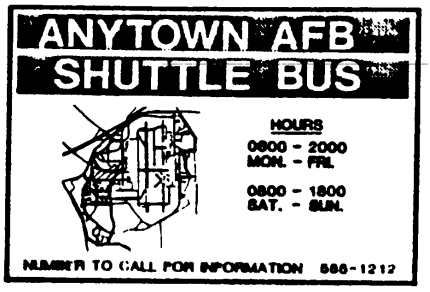
New Local or Express Bus Service - If public transit is not provided to the base, work with the transit agency to identify bus alternatives. LOCAL bus service is usually an extension of the agency's current service area. EXPRESS bus service provides commuters with a direct trip from some point off the base to designated employment sites on base. Use the results of an origin/destination survey (Chapter 2) to identify where the base employees live, in order to determine the feasibility of express buses. Express buses can also be operated by private bus carriers or by the base itself.

Bus Stop Revisions - Bus stop locations can be changed to better serve new building locations, such as a relocated BX. Occasionally there are too many bus stops, which tend to slow down buses and provide a less reliable service. Generally, a limit of eight bus stops per mile of a route is suggested. Well placed stops can provide identity to the bus service as well as make the bus more convenient for possible users.

Bus Management Changes

The base planner should be aware of the following management factors as a way of increasing bus system productivity. These factors are especially relevant for a base-operated shuttle bus.

Marketing Programs - Advertising, market research, and other promotional activities can increase the bus system visibility. The base can provide outlets for public bus pass sales and map and schedule distribution.

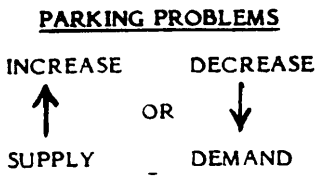


Maintenance Improvements - This category includes any actions to change the frequency, scope and quality of vehicle maintenance to improve reliability, performance, and productivity. Cost accounting development and other management tools to improve decision-making may also be included.

Bus Vehicle Improvements - Bus fleet modernization or the provision of different-sized buses to serve specific parts of the base can be a useful management tool to reduce costs.

PARKING

The effective provision and management of parking to best use scarce base resources should be a major base planning task. Planners may use several approaches to MATCH THE PARKING SUPPLY WITH PARKING DEMAND. Traditionally, parking supply is increased in response to more vehicle demand on base. Recently, however, low-cost efforts are being aimed at reducing parking demand and thus eliminating the need for new parking supply.

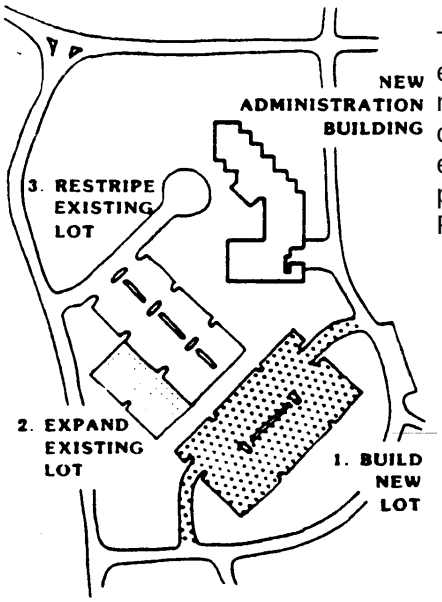


Change Parking Supply

Parking supply can change by three basic methods:

1. Build new parking lots
2. Expand existing lots
3. Restripe existing lots for more spaces.

The first two actions can require extensive construction effort and cost. The third action, restriping, can involve narrowing some parking space widths to accommodate small cars, or can involve revising the lot layout to be more efficient. These efforts often can produce a 10 to 20 percent increase in lot capacity. It is a policy of the Air Force to provide off-street parking and to minimize on-



INCREASE PARKING SUPPLY OPTIONS

EXAMPLE

OFF - STREET PARKING

NEW
ADMINISTRATIVE
BUILDING
1000 EMPLOYEES

- IDENTIFY PARKING REQUIREMENTS FROM EXHIBIT D-1 IN APPENDIX D. (REQUIRED SPACES = 50% OF ASSIGNED PERSONEL)
- MULTIPLY BY UNIT MEASUREMENT. REQUIRED SPACES = 0.50 * 1000 = 500 SPACES

POSSIBLE REFINEMENTS

1. COMPARE TO COUNTS AT EXISTING ADMINISTRATIVE BUILDINGS
2. COMPARE TO NON-MILITARY PARKING STANDARDS IN LOCAL COMMUNITY

PARKING MANAGEMENT AFFECTS

- NUMBER OF PARKED VEHICLES
- LOCATIONS OF PARKED VEHICLES
- DURATION OF PARKING

street parking. AFM g&43 (Ref. 20) provides more details on parking patterns suitable for various situations.

Off-street parking lots provide vehicle storage at or near the activity creating the need. Since different land uses generate different parking demand rates, parking requirements vary accordingly.

The Air Force has established off-street parking space requirements for base land uses (AFM 3&2 Ref. 17) as shown in APPENDIX D. Base planners may use two techniques in refining these requirements for specific applications on a base. FIRST, make parking demand calculations at those land uses with identified supply problems. Count the number of cars associated with specific land uses and compare the parking demand with that estimated using the requirements, be sure to count parking demand for the peak time. For example, at the BX or Commissary, Saturday afternoon counts should be completed; for housing areas, evening counts are needed; for administrative uses, mid-morning and mid-afternoon counts should be taken.

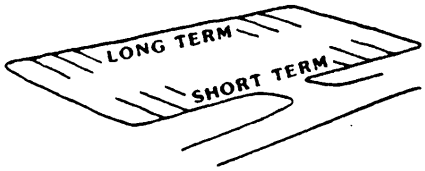
A SECOND technique is to compare the Air Force requirements with non-military standards. Use of local parking requirements guidelines may be important when Air Force parking requirements are higher than local standards. Depending on local zoning control over base activities, base parking requirements may have to be raised for new land uses or redevelopment, to comply with local standards. Contact the local zoning agency to verify the extent of local police power or regulatory authority over base parking supply.

Change Parking Demand

Parking demand changes can be achieved through the use of PARKING MANAGEMENT. The purpose of parking management is to adjust the parking demand to meet the available supply. This implies a need to change not only the

TYPICAL SHARED PARKING ARRANGEMENTS

- COMMUNITY (COMMERCIAL)/ADMINISTRATIVE
- COMMUNITY (COMMERCIAL)/COMMUNITY (SERVICE)
- COMMUNITY (SERVICE)/OUTDOOR RECREATION
- ADMINISTRATIVE/HOUSING



MANAGE PARKING SUPPLY IN LOTS

number of parked vehicles, but also the locations at which they are parked, and the duration of parking.

Parking Restrictions (on-street, off-street) - This action is aimed at controlling the mix of short and long-term parking. ON-STREET restrictions have limited applicability on a base because of the limited street capacity and minimal on-street parking.

OFF-STREET parking restrictions at major base activity centers can deal with many parking-related problems. For instance, on bases with large numbers of civilian, day-time office workers, a strong need for day-time VISITOR parking may require changing the mix of short and long term parking when all day Commuter parkers take all the spaces. The provision of clearly marked visitor spaces, in conjunction with better enforcement and some type of bus shuttle service from an outlying parking lot might be effectively employed.

Priority Spaces for Carpools - Parking spaces reserved for carpools are used to encourage ridesharing and to reduce the commuter parking demand on the base. Designate priority carpool spaces in parking lots serving employment sites. For maximum incentive, locate the priority spaces as close to the building as possible, making sure not to disrupt other spaces reserved for ranking officers. The Manual on Uniform Traffic Control Devices (Ref. 47) has signing standards for priority carpool spaces.

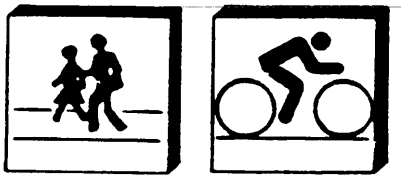
Shared Parking - Parking demand patterns vary among land uses. When two or more distinguishable land use types, (e.g., administrative and commercial) have a common parking area for use of their tenants or customers, this is termed SHARED PARKING. Shared parking can result in lower individual parking space requirements because complementary land uses can have different peak parking times or can attract the same users with a single auto trip (e.g., Commissary, Bx). In turn, this may result in reduced

parking construction requirements for redevelopment or new development.

Parking space savings of 5 to 25 percent could be expected with shared parking. For example, a base community Center design could place a chapel nearby, with the chapel's peak hours coming when the BX/commissary are closed, and vice-versa. Another good use of shared parking is for AFRES facilities as these uses are typically weekend- sponsored. Reservists could share other "weekday" use parking areas, rather then build their own parking facilities.

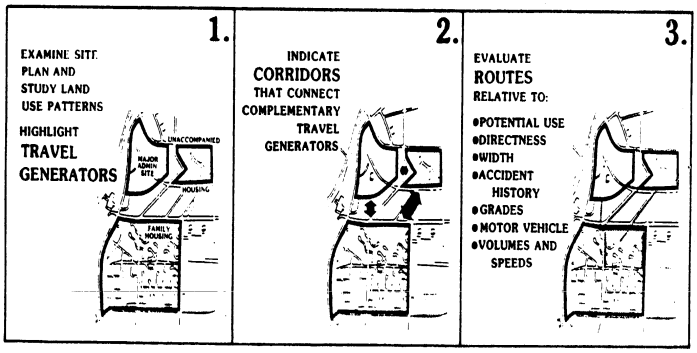
Enforcement - The best planned parking management system will fail without conscientious ENFORCEMENT. Because the Air Force owns all on-base parking facilities, enforcement actions such as ticketing, towing, or "booting" would be available either off- or on-street. Before implementation, ensure that both military and civilian users will be within the legal reach of proposed enforcement tactics. Cooperation with local authorities may be required to ensure prompt processing of parking violations.

PEDESTRIANS AND BICYCLES



The use of pedestrian and bicycle modes for commuter purposes and recreational uses has increased dramatically during the last decade because of both energy problems and greater public concern with physical fitness. Land-Use planners should consider transportation actions aimed at encouraging

IDENTIFY LOCATIONS FOR PEDESTRIAN /BICYCLE FACILITIES

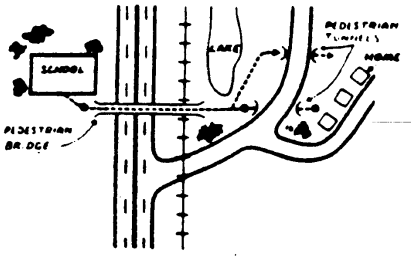


greater walk or bicycle commuting by the base work force since walking and biking can decrease traffic congestion parking problems, and result in cleaner air. At the same time, improve the safety of bikers and walkers by carefully planning pedestrian and biking facilities. AFM 88-43, (Ref. 20) and MTMC Pamphlet No. 55-16 (Ref. II) provide detailed pedestrian and bicycle facility design guidance.

To the extent that new bikeway and pedestrian facilities are needed for new or expanding base uses, planning requires careful review of location alternatives. Generators of pedestrian and bicycle traffic should be conveniently linked together by an overall network of facilities designed with the parameters of maximum walking or biking distances. Facilities leading to shopping and work locations should be as short and direct as possible, while recreation-oriented paths should be more indirect but scenic.

Bicycle and pedestrian actions typically fall into the following categories: ENGINEERING, EDUCATION, or ENFORCEMENT. Proper engineering design and linkage among major activity centers, education of principal users in the safe use of the facilities, and the enforcement of simple regulations are the factors to be considered in the planning process.

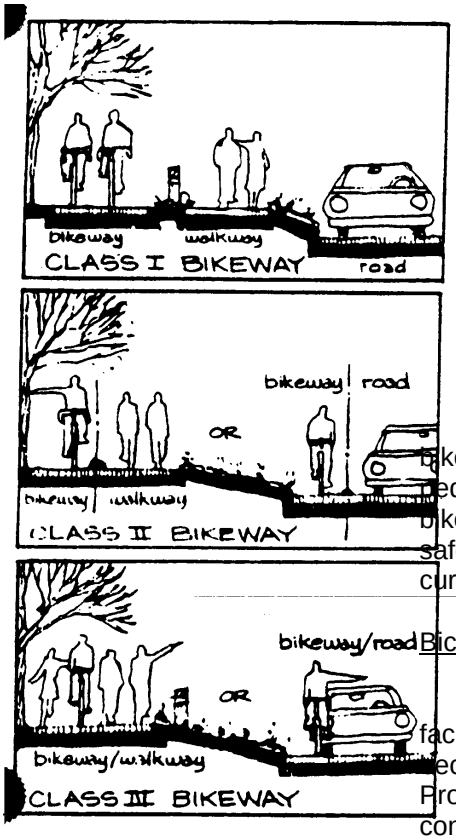
<u>Bikeways</u>



BUILD IN PEDESTRIAN AND BIKE TRAILS, OVERPASSES AND UNDERPASSES

Bikeways are facilities designated for travel by bicycles. A bikeway system should provide direct routes between primary traffic origins and destinations within an installation. Safety considerations in planning bikeways include minimizing potential conflicts between bikes, pedestrians and vehicular circulation and eliminating potential stationary hazards along the bikeway network.

Generally, there are three classes of bikeways that define the degree of exclusiveness for bicycle use:



- Class I: A COMPLETELY SEPARATED RIGHT-OF-WAY designated for the exclusive use of bicycles. Crossflows by pedestrians and motorists are minimized**.** Typically used for commuter and recreational purposes.

- Class II: A restricted right-of-way designated for the SEMI-EXCLUSIVE USE OF BICYCLES. Through travel by motor vehicles or pedestrians is discouraged. However, crossing over by pedestrians and motorists is allowed.

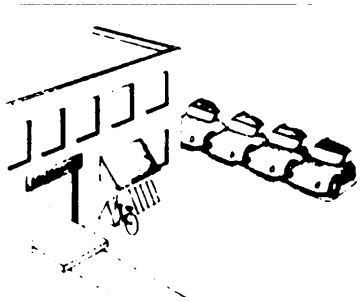
- Class III: A RIGHT-OF-WAY SHARED with either moving motor vehicles or pedestrians. Right-of-way is identified by signs or pavement markings.

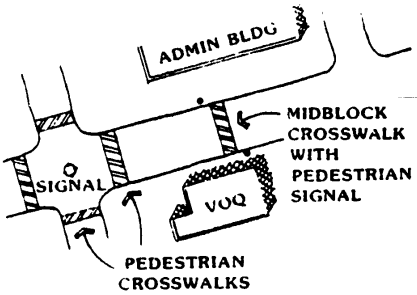
Because of scarce land resources on many bases, Class III bikeways, permitting the joint use by bikes and other vehicular or pedestrian traffic may be the most frequently constructed. Joint use of bikeways by joggers and runners may even exceed bicycle use. Take safety precautions on all bikeways relative to clearances, grades, curves, sight distance, crossings, and surface pavements.

Bicycle Parking Facilities

In many instances on base, inadequate bicycle parking facilities are provided. Consequently, sidewalks and building entrances become blocked. Poor location of bike racks is another problem. Proper consideration for location and demand is necessary to provide convenient bike parking facilities.

Locate parking areas out of pedestrian pathways but in areas which have good access to buildings. Provide secure racks or storage lockers to prevent theft.





Pedestrian Crosswalks and Signalization

Pedestrian safety is improved through proper placement and marking of crosswalks and provision of pedestrian traffic signals. Crosswalks should be striped at all intersections which have pedestrian movements. Signals are limited to the locations with heaviest pedestrian volumes, such as adjacent to housing areas, near community centers, and next to large administrative buildings. A pedestrian signal can be installed together with a traffic signal or separately at a midblock location.

Pedestrian Walkways

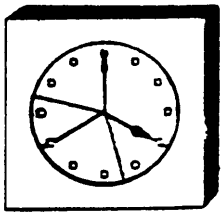
Plan pedestrian walkways to serve the origin-destination movements on-base in a safe manner. Walkways should be located in such a way to minimize conflicts with vehicle traffic. Generally, as traffic volumes increase, there is a need to move the walkways away from the traditional sidewalk parallel to the street. Walkways interior to a block provide the best access among land uses and separates the vehicular/pedestrian traffic. Grade separated walkways provide the greatest separation, but at a high cost. Other planning considerations are street lighting, crosswalks, ramps, traffic signals, pedestrian islands, and pedestrian signing.

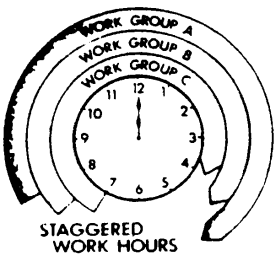
WALKWAY LOCATIONS

- PARALLEL TO STREET
- INTERIOR TO THE BLOCK
- ARCADES
- GRADE SEPARATED, CROSSINGS

ALTERNATIVE WORK SCHEDULES

A single reporting time for base personnel results in traffic congestion. Non-standard or alternative work schedules will result in more balanced traffic demand. Alternative work schedules are variations from the national work hour norm of five eight-hour workdays per week. There are three major types--STAGGERED WORK HOURS, FLEX-TIME, and COMPRESSED SCHEDULES.





STAGGERED WORK HOURS vary the work schedules of selected employees groups by moving daily starting and stopping times forward or backward, some outside the normal peak period. Most Commonly, the employer assigns various employee groups their start and finish times at l 5 or 30 minute intervals.

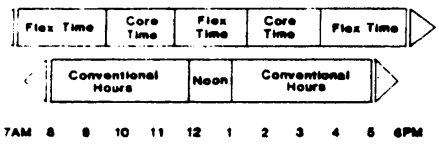
FLEX-TIME is a system in which the employees select their own start and finish times within set guidelines. The range of possible start and finish times may vary by several hours. This permits employees to more easily carpool or find a convenient transit schedules. Many will also change their work trips to off-peak periods to avoid congestion. The time period during which all employees are present is called the core time.

COMPRESSED SCHEDULES involve rescheduling the work week to longer hours per day but fewer days per week. The average weekly number of work trips is reduced and the employees' travel at other than the normal peak periods. The most popular schedule is either four consecutive ten-hour days, which provides a three day weekend, or nine hours daily over a two-week, nine day period (i.e., the worker has an extra day off every other week). This is often called the 5-4/9 plan, because employees work 9 days each biweekly period; 5 days one week and 4 days the other week.

Staggered and flexible work hours spread peak period traffic over a longer period. Shortened work weeks redistribute to-and-from work trips to off-peak times and decrease the total number of such trips.

The base planner, in coordination with top ranking officers, should select an advisory group of key personnel `to review specific work schedule opportunities. Administrative positions offer the greatest potential for change, while other phases of the base operations may not be as flexible. For example, jet fueling operations shift workers or maintenance personnel managers may oppose the implementation of any alternative work schedule because of

Expanded Workday on Flex Time



COMPRESSED SCHEDULES

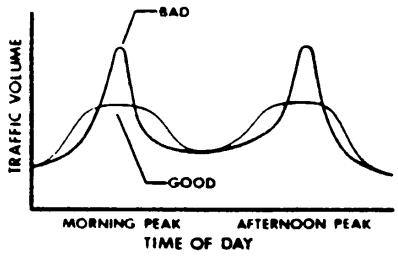
5-4/9 PLAN

	M	T	W	Th	F	
WEEK 1	9	9	9	9	8	44
WEEK 2	9	9	9	9	OFF	36
					TOTAL HOURS	80

4 DAY WEEK

M	T	W	Th	F
10	10	10	10	OFF

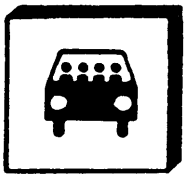
TOTAL HOURS 40

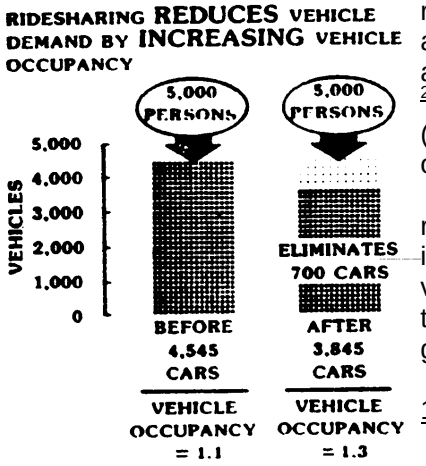


ALTERNATIVE WORK SCHEDULES

- IMPROVE JOB SATISFACTION
- IMPROVE WORKER PRODUCTIVITY
- REDUCE ABSENTEEISM

a limited number of properly trained personnel. If such limitations are real and not just perceived, alternative work schedules would not provide an appropriate complement of qualified personnel for the 24-hour operation.





RIDESHARING

- o DECREASES DEMAND FOR PARKING SPACES
- o LESSENS CONGESTION
- o PROVIDES EMPLOYEE COST SAVINGS
- o REDUCES ABSENTEEISM
- o PROVIDES GOOD COMMUNITY RELATIONS

RIDESHARING

It is the policy of the Federal government that it's agencies vigorously promote ridesharing within their facilities. The term RIDESHARING has evolved to mean any alternative to “drive-alone" commuting. Although this broad definition would include bus commuting, the primary ridesharing modes are CARPOOLING and VANPOOLING. CARPOOLING is two or more persons traveling together on a continuing and pre-arranged basis. VANPOOLING results when a driver and approximately eight or more passengers agree on a daily commuting route, share costs for the trip, and travel in a van.[1/] Vans typically are either owner-operated, company-sponsored,[2/] or provided by a third-party.[3/] MTMC Pamphlet 55-16, Volume ll (Ref. 11) describes many aspects of ridesharing pertinent to military organizations.

Because of its low Cost and good potential benefits, ridesharing is an important technique to be considered. Ridesharing increases average vehicle occupancies, which in turn results in fewer vehicles for the same numbers of people. The data collected as part of the traffic inventory (see Chapter 2) provides baseline conditions to guide the ridesharing program.

1/ The most popular vehicle for vanpooling is either the 12- or 15-passenger model. An eight-passenger minimum is usually required before operation begins.

2/ As the federal government may not make its vans available to user drivers, as private employers frequently do, this option is probably infeasible.

3/ Sometimes a base credit union will act in this role, or give preferential financing to an owner-operated vanpool.

Because of the increased public agency and private employer support of ridesharing programs a surrounding community government unit may operate a ridesharing program for the region. Base planners should learn the range of local ridesharing program services, to avoid duplicating services already provided. Such programs frequently provide ridesharing guidelines to area employers and may help plan or actually perform the ridesharing effort on-base.

OTHER CONSIDERATIONS

There are special characteristics of an Air Force Base which require the planner to analyze innovative transportation alternatives. There is flexibility required by the Air Force in performing its mission, resulting in sudden temporary or permanent changes in traffic demand. Security needs are also important, both for access to and from the base and for separation of aircraft operations and other-sensitive materials and activities from other vehicles, persons, and areas. The following sections describe some of these topics as they relate to the development of alternative transportation plans.

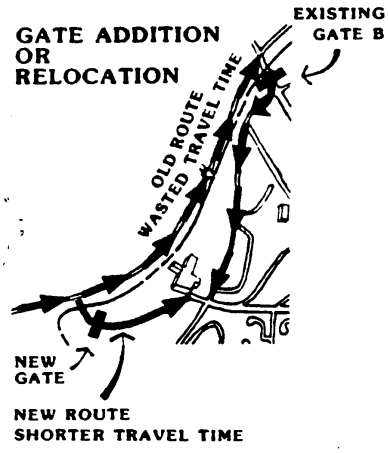
Access and Security

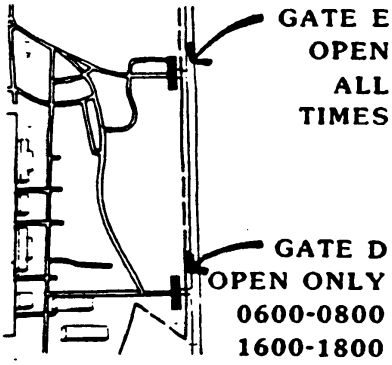
TRADEOFFS NEEDED

The transportation planner must consider two primary needs of an air base - ACCESS to and from the base, and SECURITY within the base.

ACCESS to a base is controlled at gates for security purposes. However, existing gates may be inadequate to handle increasing traffic loads or changes in travel patterns caused by changes in land uses either on or off the base.

As a result, the planner may need to consider alternative access plans. Generally, these alternatives fall into three categories: modifying existing gates, relocating gates and





LIMIT NUMBER OF GATES FOR SECURITY REASONS

building additional gates. MODIFYING EXISTING GATES can improve capacity and safety by removing lateral restrictions, widening or adding lanes, or revising security measures during peak periods. Details of gate design arc provided in MTMC Pamphlet No. 55-15 (Ref. 10)

RELOCATING GATES involves moving a gate for the purpose of travel times and distances or for some other purpose. Since this action involves no change in the number of gates, base security usually is not affected adversely, and may even be improved.

BUILDING AN ADDITIONAL GATE(S) can be a viable alternative when the base activities are growing substantially, creating a burden on existing gates. Gates are also added to direct access to a portion of the base not currently served. Finally, there may be pressure from in the surrounding community to add a gate to reduce the traffic burden on certain roadways adjacent to the base. Adding gates affects base security in that more checkpoints are required. One option used has been to have certain gates open only during peak traffic hours and closed at other times.

SECURITY often controls the location or design of gates and influences internal base circulation. Gate location alternatives may be affected by their proximity to sensitive - material storage areas or other high security facilities.

Within the base, the need for security can affect roadway use. High security areas typically are separated by gates with no through traffic permitted. Periodic movements of sensitive material, flight crews, or equipment may force the closure of selected streets. To the extent possible, designate specific routes for these movements and include workable alternative routes in the planning process. Security and safety concerns also requires the SEPARATION OF AIRCRAFT from other vehicles. Often this necessitates a perimeter road encircling the runways or a tunnel underneath the runways. This separation places a constraint on the alternative plans that can be considered.

SECURITY PLANNING

- LOCATE GATES AWAY FROM SENSITIVE STORAGE AREAS
- PROVIDE FOR MOVEMENTS OF SENSITIVE MATERIALS, FLIGHT CREWS, OR EQUIPMENT
- SEPARATE AIRCRAFT FROM OTHER VEHICLES

Hazardous Materials

The Air Force regulates base policies regarding the transportation of hazardous materials for military air shipment under AFR 71-4 (Ref. 12). This document covers the transportation of hydrazine, a specialized and highly volatile air plane fuel, as well as other substances.

U.S. Department of Transportation (USDOT) regulations[1/] apply primarily to shippers but have relevance to hazardous material transportation on the base. Additionally, the Environmental Protection Agency (EPA) has issued regulations[2/] governing the exposure and use of specific hazardous materials.

HAZARDOUS MATERIAL MOVEMENTS

- PROVIDE DIRECT ACCESS TO/ FROM GATES
- PROVIDE SUFFICIENT ROADWAY WIDTH AND TURNING RADII FOR TRUCKS
- AVOID HOUSING AREAS
- SCHEDULE DURING LOW CONGESTION PERIODS
- PROVIDE RIGOROUS ENFORCEMENT

Plan for safe access to and from the base when managing the transportation of hazardous or potentially explosive materials. As new facilities are planned or roadways modified, consider the location of base activities that must process and dispose of hazardous materials. For example, provide direct access to arterial roadways from airline hangars without travel through housing areas. Also provide sufficient width and turning radii for any special equipment used in the transportation of hazardous materials.

Schedule hazardous material transportation for the least congested periods. For most base, duty hours between 2400 and 0600 present the least potential vehicular conflicts. Additionally, use routes on the base that minimize stops and delays and that are specifically signed for shipper use.

Distribute base maps with clearly marked routes for hazardous materials. Further, plan for rigorous enforcement of regulations affecting these routes.

Energy Planning

Transportation planning must be related to energy planning, as described in the 1983 Air Force Energy Plan

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1/ 49 C.F.R. parts 171 to 189
2/ 40 C.F.R.

ENERGY EFFICIENCY

- O MINIMIZE TRAVEL DISTANCES
- O MINIMIZE STOPS AND DELAYS
- O ELIMINATE VEHICLE TRIPS
- 0 CONSOLIDATE ESSENTIAL TRIPS

(Ref. 22). To accomplish its basic mission--aircraft operations -- the Air Force must maintain large numbers and variety of aircraft. As a result, the availability of appropriate and plentiful fuels during an energy emergency could have a profound effect on the mission and on the operation of the base.

In addition, energy costs are of concern. Aggressive programs on base have been developed to conserve energy and to increase energy efficiency. Therefore, GIVE SPECIFIC ATTENTION TO ENERGY REQUIREMENTS DURING THE SELECTION AND EVALUATION OF ALTERNATIVE TRANSPORTATION PLANS.

Much of the energy conservation program is focused on aircraft, vehicle, and installation operations. The planner has the greatest latitude relative to vehicle operations in that the BCP should contain actions which help MINIMIZE TRAVEL DISTANCES, STOPS, AND DELAYS, each of which affects vehicle energy use. To further minimize energy use, the energy plan seeks to ELIMINATE UNNECESSARY VEHICLE TRIPS AND CONSOLIDATE ESSENTIAL TRIPS whenever possible. To accomplish this objective, give particular emphasis in the plan to ridesharing (including carpooling and vanpooling), bus facilities and services, priority carpool parking and bicycle/pedestrian facilities. The energy plan will be incorporated as a component of the BCP.

Environmental Factors

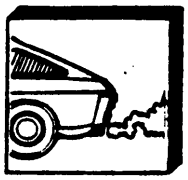
Transportation plans affect the functioning of the natural environment. No transportation improvement is without both positive and negative effects on the environment. Only certain impacts, such as changes in air quality, visual appearance, noise levels, and level of service degradation can be effectively quantified and evaluated. Others, such as aesthetics, effects on established neighborhoods, and social

TRANSPORTATION PROVIDES INPUT TO

- o NATURAL RESOURCES PLAN
- o ENVIRONMENTAL DESIGN PLAN
- o ENVIRONMENTAL PROTECTION PLAN

TYPES OF POLLUTANTS

- o CARBON MONOXIDE (CO)
- o HYDROCARBONS (HC)
- o NITROGEN OXIDES (NO_X)



impacts, are more difficult to measure.

The planner should understand the basics of these factors during the selection of feasible alternatives. References 32 and 41 are good sources for specific information about transportation and the environment.

Air Quality - Air quality is defined relative to the amount of containments or pollution in the air. The contaminants are both natural and man-made. Transportation pollution is caused principally by traffic; therefore, MORE TRAFFIC EQUALS MORE POLLUTION. Actual pollution emissions from vehicles vary according to temperature, vehicle condition and habits, age, driving (including speeds), numbers of stops and slow downs, and stop delay.

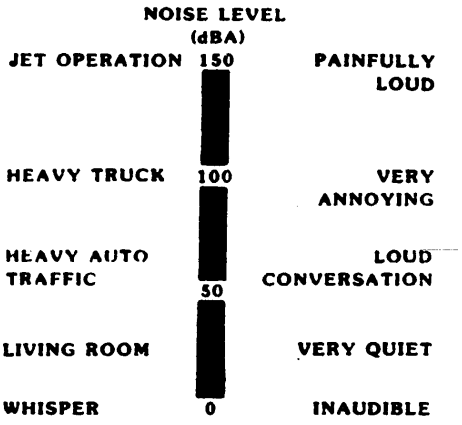
Emissions are largest for gasoline engines found in cars and small trucks, while large trucks and buses fueled with diesel are roughly 14 times less polluting. Diesel emissions do create a noxious odor, however. Various federal regulations exist for Ambient Air Quality Standards. The Environmental Protection Agency updates these standards annually.

In order to minimize pollution, consider those alternatives which either MINIMIZE VEHICULAR TRAVEL (e.g., ridesharing, bus, bicycle, pedestrians) or else ENSURE SMOOTH VEHICLE FLOW. Take special care to locate sensitive land uses such as schools, hospitals, or housing units away from congested roadway and parking lot exits with poor air quality conditions. Alternatively relocate major streets and parking lots away from these sensitive sites.

Noise - All transportation facilities and vehicles produce noise, which can be defined as unwanted sound. Noise occurs during construction as well as during the operation of a facility. Perhaps the most evident noise is from aircraft operation, although noise from surface vehicles such as automobiles, trucks, motorcycles, buses, and from industrial

sources is more widespread. The loudest sounds are generated at intersection and gate areas, by stopping and starting vehicles. Perceived noise level is measured in a unit called DECIBELS (dB). The Federal Highway Administration has designated various noise standards and has established procedures for estimating noise caused by transportation changes.

Consider transportation actions which minimize noise in sensitive areas of the base, particularly near housing areas, schools, hospitals, theaters, and special Air Force facilities requiring quiet conditions. Several appropriate planning actions are listed below.



NOISE

TYPICAL NOISE CONTROL ACTIONS

Traffic Planning

- Reroute traffic using peripheral roads, commercial vehicle routes and prohibitions, and relocated bus routes and bus stops.
- Use traffic engineering techniques to smooth-out traffic flow and reduce stops and starts
- Enforce engine muffling and other equipment - regulating standards

Design

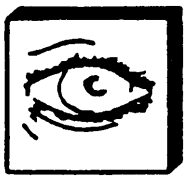
- Reduce vertical grades and use depressed roadway alignments.
- Improve pavement conditions.
- Relocate roadways away from sensitive areas, often taking advantage of natural barriers, such as hills or trees.

- Construct noise shielding, which includes artificial screens or walls placed adjacent to a roadway. natural shielding, using trees or shrubs can also be used, but are less effective sometimes.

Land Use Planning

- Locate sensitive land uses away from high noise areas. Conversely, plan nonsensitive land uses (e.g., parking, industry, warehouses, etc.) next to higher noise facilities.

Visual Effects

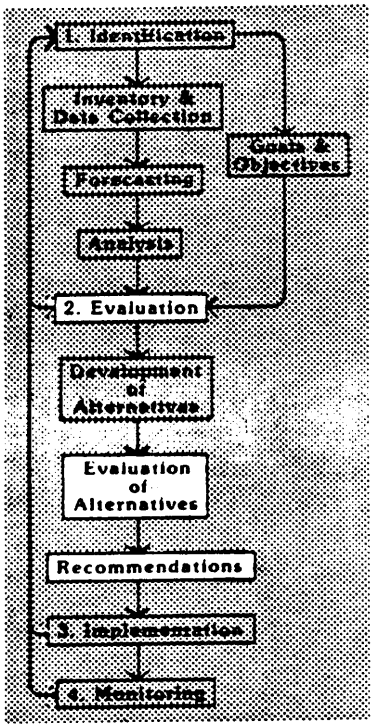


The visual impact of transportation facilities is the basis on which many persons judge a "good" or "bad" environment. Therefore, in planning, EMPHASIZE THE PHYSICAL SETTING, including the blend with open spaces and built-up areas. Primary areas of concern for the transportation planner are the following:

- alignment of roadways through neighborhoods
- width of roads
- landscaping of roadways
- locations of bus stops
- frequency and location of signs
- sidewalks.

Use these considerations to guide the selection of alternatives, even though many specific visual features will not be evident until a project reaches the design phase.

CHAPTER 5



EVALUATION AND RECOMMENDATION

The adoption of a transportation plan should occur after a process of designing and testing several alternative plans. Compare and eliminate one-by-one through an evaluation process until a relatively small number of feasible alternatives remain. Then evaluate the remaining alternatives in depth to determine which plan best serves the based needs, as defined in the goals and objectives statement.

Evaluation, simply stated, is the examination of the impacts of each alternative for the purpose of deciding on the "best" plan. Evaluation addresses the following concerns:

- Whether a plan is worthwhile.
- Whether a particular plan is more worthwhile than another plan

Be sensitive to the specific objectives of key persons who will make the ultimate decision to accept or reject the recommended plan.

It is also necessary to ask when the plan will be worthwhile. Since the time period from plan to construction may be several years, it is important to determine whether the plan is worthwhile today or will be after 10 or 20 years.

USE A SYSTEMATIC APPROACH TO EVALUATION. Properly consider each objective, make adequate predictions of impacts, select an accurate means to compare alternatives, and make sure that the resulting plan is implementable.

MEETING THE GOALS AND OBJECTIVES

The most straightforward way to evaluate an alternative is to determine how well it meets transportation planning objectives. Since OBJECTIVES SHOULD BE MEASURABLE, as discussed in Chapter 2, the planner can "measure" the performance of each alternative. The specific means of

1. IDENTIFY OBJECTIVE

EXAMPLE: MINIMIZE TRAVEL TIME

2. SELECT CRITERIA

o POINT-TO-POINT TRAVEL TIME
o VEHICLE DELAY

3. SET STANDARDS

o MAXIMUM 10-MINUTE TRIP BETWEEN ANY ON-BASE HOUSING AND COMMUNITY CENTER
o MAXIMUM 60 SECONDS/VEHICLE DELAY AT INTERSECTIONS

CONSIDER TECHNICAL AND NON-TECHNICAL CRITERIA

GIVEN: PROPOSED NEW ROAD PAST FAMILY HOUSING AREA.

TECHNICAL CRITERIA	NON-TECHNICAL CRITERIA
o TRAVEL TIME	o VISUAL APPEARANCE
o DELAY	o CHILDREN'S SAFETY
o COST	o HEADLIGHT GLARE
o ACCIDENTS	

comparison are called CRITERIA or MEASURES OF EFFECTIVENESS- Minimum or maximum allowable values for criteria are called STANDARDS- APPENDIX C includes a detailed list of criteria for various types of transportation objectives.

In practice, only a very small set of criteria (i.e, five or ten) are used in evaluation. However, be sure to have a wide enough variety of criteria to address pertinent technical and non-technical concerns about the project. For example, a study of alternative roadway alignments should consider obvious technical objectives (e.g., reduce travel time, improve access to base facilities, etc.), but also should consider several less technical objectives (e.g., minimize visual impact on adjacent housing areas, maintain safe environment for children, etc.).

EVALUATION TECHNIQUES

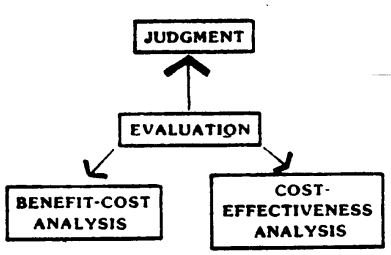
Many factors are involved in evaluation, and a truly optimal solution is rarely possible. Rather, aim to choose the alternative that best meets the objectives, keeping in mind various administrative or cost constraints which would influence the ability to implement a project.

There are three basic evaluation techniques - JUDGMENT, COST-EFFECTIVENESS ANALYSIS, AND BENEFIT-COST ANALYSIS- The selected technique can vary among the three, as long as it is capable of consistently producing a preferred alternative.

APPENDIX C provides a complete description of each evaluation technique. A synopsis is provided below.

Judgment - a non-technical decision based on professional experience and a review of the pros and cons of an alternative.

Cost-Effectiveness Analysis - a method used to analyze the consequences of an action in terms of the results produced and the resources required to produce those



results. The impacts for the alternatives are compared individually by displaying them side-by-side in a table. Impacts can also be combined into a total "score" for each alternative.

Benefit - Cost Analysis - a method used to identify the "high payoff" alternatives by comparing the benefits of an alternative to its costs. All impacts are converted to a monetary base that can be used to compare alternatives for several different years.

When should I use a particular evaluation technique?

Although there are no specific rules for deciding when to use a particular evaluation technique, the following chart provides the planner with some guidance for typical situations.

SITUATION	MOST APPROPRIATE TECHNIQUE(S)
• Evaluate one or two proposals for low cost improvements, such as to upgrade an intersection or change a shuttle bus service.	• Judgment and simplified cost-effectiveness analysis
• Compare various alternative actions for inclusion into the BCP.	• Cost-Effectiveness analysis
• Compare different alternatives within different time periods.	• Cost-effectiveness analysis and Benefit-cost analysis
• Consider major highway construction alternatives	• Benefit-cost analysis

PERFORM MOST TRANSPORTATION EVALUATIONS ON AIR FORCE BASES USING A STRAIGHTFORWARD COST-EFFECTIVENESS DISPLAY OF IMPACTS - Since the number of alternatives and list of criteria likely will be small, the decision-maker will be able to sort through the alternatives without a rigorous benefit-cost analysis. For larger projects involving major changes in the transportation system, supplement the cost-effectiveness study with a benefit-cost analysis.

Cost is a major factor.

In all cases, COST will be a major factor in the decision. Obviously, an alternative that exceeds the possible budget or takes too large a slice may have to be dropped from further consideration, thus simplifying the evaluation of other alternatives.

MEASURING THE COSTS

Accurate cost estimates are needed to evaluate transportation alternatives. There are two primary cost components--capital and operating.

CAPITAL costs are usually the easiest to measure, since they are a one time expenditure and are based on prior experience. For planning purposes, detailed estimates of each capital cost item are usually not required. The general technique is to estimate a per mile or per vehicle lump sum cost which includes many of the specific items listed above. For instance, new roadway construction generally costs conditions will vary from base to base.

TYPICAL CAPITAL COSTS

- RIGHT-OF-WAY ACQUISITION
- CONSTRUCTION
- EQUIPMENT

OPERATING costs consist of maintenance and operations charges that are recurring throughout the life of the investment. Maintenance costs include routine upkeep, replacements, and equipment repair. Operations costs include special day-to-day operating needs of a project. In practice, operations costs can often be lumped together with maintenance costs for estimating purposes. However, a special operation, such as a shuttle bus service, should have separate Operating cost estimates for vehicle operation, driver wages, and vehicle leasing (if appropriate). Such costs often can be put on a "per route mile" or "per day" basis. Determine most operating costs from records of the base engineering department or from the public works department in the surrounding community.

TYPICAL OPERATING COSTS

- ROUTINE MAINTENANCE
- REPLACEMENTS
- EQUIPMENT UPKEEP
- SAFETY PATROLS
- BUS SYSTEM MANAGEMENT

Also, indirect costs occur because the project often creates unforeseen expenditures downstream from its implementation. For instance, the purchase of new shuttle buses could lead to a need for purchasing a new maintenance

facility, installing new bus stop signs, or hiring additional drivers. At the same time, the money and labor used for one project will not be available for another project, creating an implied cost for "lost opportunities." Indirect costs are important to the base planner to the extent that they should be considered, if not quantified, in an evaluation.

FOR MOST TRANSPORTATION PLANNING PURPOSES, THE IMPORTANT RULE OF COSTING IS TO INCLUDE THOSE COSTS FOR AN ALTERNATIVE THAT ARE DIFFERENT FROM THOSE OF OTHER ALTERNATIVES. Include the Costs that are readily attributable, using the best estimates available at the time of the analysis. Where there is uncertainty regarding the cost estimates, use a range of values to span the range of uncertainty.

MAKING A RECOMMENDATION

After completing the evaluation, the planner will need to make a RECOMMENDATION of a preferred alternative. Clearly describe and justify the recommended transportation actions so that the decision-makers can make an intelligent decision whether or not to implement the projects. Also provide adequate detail to obtain the needed programming and budgeting commitments.

RECOMMENDATIONS INCLUDE:

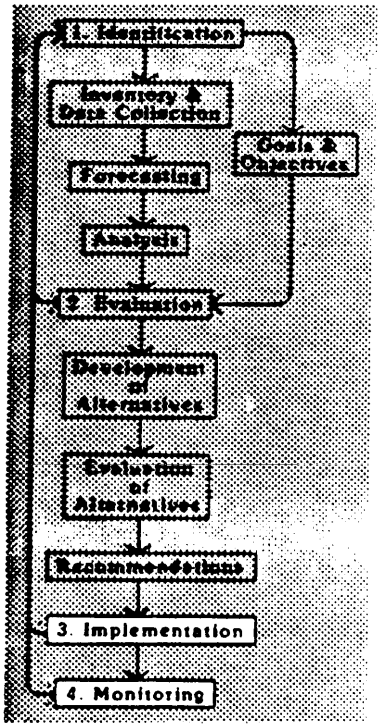
- NEED FOR PROJECT
- DESCRIPTION OF PROJECT
- SCHEDULE
- COST (CAPITAL, OPERATING)
- ORGANIZATIONAL PLAN

Although most recommended projects will be located on the base, others will pertain to needs on the transportation system SURROUNDING the base. For example, a recommendation to improve traffic flow at a gate could also include actions to be taken on the off-base roads approaching the gate. A recommendation for a new public bus service to the base could affect the operations of the regional transit agency. In each case, cooperate with civilian highway or transit agencies to ensure that the recommendations can also be incorporated into the work programs for those agencies.

APPENDIX A contains recommended short-term and longterm improvements for the Anytown Air Force Base example.

CHAPTER 6

MAKING IT WORK: IMPLEMENTATION AND MONITORING



Transportation planning leads to the IMPLEMENTATION of the recommended action. The actual implementation of a project is not part of the planning process. However, planning provides data and assistance for the implementation. A major element of the BCP is a summary of the recommendations in a prioritized order which will lead the way to implementation.

The planning process also provides a means to MONITOR conditions after implementation. Monitoring should be an ongoing activity to make sure that the improvements perform as expected and to make adjustments as necessary.

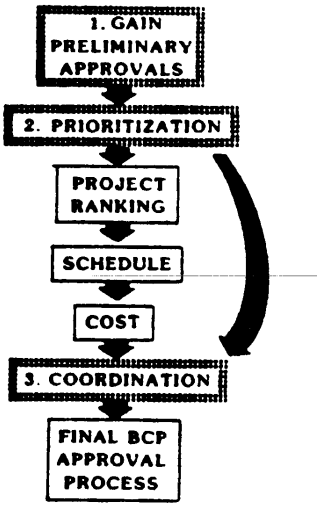
IMPLEMENTATION

Implementation is the result of matching the recommended projects with available funds to accomplish both the short and long-range objectives of the base. Unfortunately, too often planning and implementation have been separated, even though the two should be visualized as directly interrelated.

All projects should be part of and consistent with the base's Transportation Plan Component of the BCP. Such actions as street improvements, alignment changes, or signalization improvements that are necessary to support specific land use developments should be included in the design contract as well as in the building construction contract. Therefore, the implementation of the land use and transportation plans must be coordinated.

Three elements make up the implementation process- APPROVALS, PRIORITIZATION, and COORDINATION.

IMPLEMENTATION PROCESS

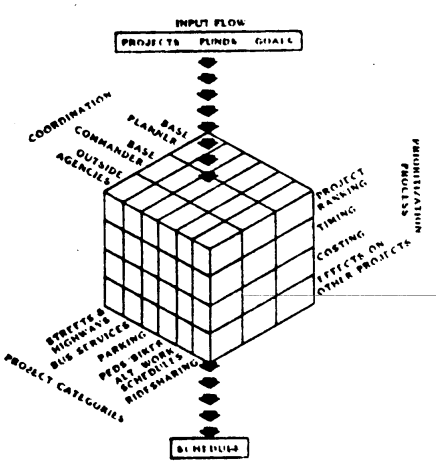


Approvals

Obtain preliminary APPROVALS for the transportation recommendations from the base decision-makers prior to their

inclusion in the BCP. This first round of approvals is important to make sure that the recommendations to be included in the BCP represent realistic and attainable actions. A final round of approvals of the entire BCP will occur later.

Prioritization



PRIORITIZATION IS THE ACTUAL PROCESS USED TO DETERMINE A RANKING OF RECOMMENDED PROJECTS. Prioritization also establishes a SCHEDULE and COSTING plan for inclusion of short-range recommendations in the five-year Capital Improvements Program (CIP) required in the BCP. Key elements of prioritization are discussed below.

Envision prioritization as the meshing of three elements- - projects, funds, and goals. One set of inputs is the recommended list of PROJECTS; the second input is FUNDING, which is estimated through financial planning; and the third input is GOALS. Goals and related policies help match project priorities with available funds to prod-ice an effective program of transportation improvements. The base planner has input to this effort.

The base planner should consider various funding sources.

Funding - In setting priorities, the base planner should consider projects from various funding sources. Some typical funding arrangements include the following:

- Military Construction Program (MCP) - Line items for transportation improvements can be included with other MCP - funded projects These projects tend to receive low priorities but this funding avenue certainly should be sought for major actions. The normal DD 1391 process would be used. Eligible projects can include base-wide upgrading of the transportation system (much as is done routinely for the base-wide electrical distribution system) or small

projects limited to a specific street extension, realignment, or other geometric change. APPENDIX A contains sample line items for an MCP program at Anytown Air Force Base.

- Operations and Maintenance (O&M) Funding - O&M funding is available for transportation system improvements up to the base's funding limits. Requests for projects to be funded under the higher MAJCOM O&M limits are also possible.
- Other - Use of Air Force teams, such as Red Horse, is possible for base street improvements. Funds for pedestrian, jogging, or bicycle trails. may be available through the base Morale Welfare and Recreation sources.

Since funds usually are insufficient to meet all needs immediately, and since in nearly every case it is physically impossible to undertake all work simultaneously, it is important to prioritize recommendations. The base planner assists in recommending a prioritized list of projects, keeping in mind several factors--the cost of the project, its timing, and its effects on other projects in the BCP.

Cost - One of the prime objectives of planning is to obtain the greatest benefits from the available funding. Therefore, COST often rises to the top among the factors for setting priorities, and, when it does, it usually is limited to direct costs and short-term values. Non-cost impacts are also important to consider since those projects which satisfy the greatest needs with minimal adverse impacts should be ranked higher, at least in theory.

Obtain the greatest benefits from the available funding.

Timing - TIMING plays an important role in setting priorities. Generally, short term projects will receive higher priority, or ranking, than those which will take longer to implement or which meet a future need. Since timing

Rank projects within certain time periods for inclusion in the CIP.

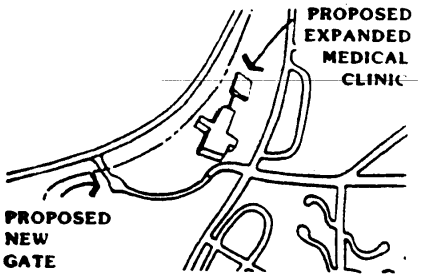
varies significantly among projects, rank projects separately within certain time periods, such as 0 to 2 years, 2 to 5 years, 5 to 10 years, etc. This format is compatible with the needs of the five-year CIP required in the BCP. Although specific scheduling is done only for the five-year CIP, establish the transportation plan so that medium-or long-range recommendations are linked to the short-term program.

Effects on Other BCP Projects - The final ranking factor is the RELATIVE EFFECTS OF THE PROJECT ON OTHER PROJECTS IN THE BCP. Generally, give lower rankings to transportation projects that could disrupt the timing or feasibility of land use development, landscaping or other projects in the BCP. Since the BCP will contain a complete ranking of all plan elements, of which transportation is one, FOCUS ATTENTION ON THOSE TRANSPORTATION RECOMMENDATIONS WHICH WILL BE FULLY SUPPORTIVE OF THE OTHER BCP ELEMENTS.

Select transportation projects that fully support other BCP elements.

Work closely with other persons involved in the BCP, since the BCP projects are prioritized together, rather than as individual elements. For example, plans for new land use developments on or off-base may have construction schedules that can be related to a transportation project's needs for right-of-way or for parking. On most bases, THE LAND USE PORTION OF THE BCP WILL DRIVE THE IMPLEMENTATION OF TRANSPORTATION IMPROVEMENTS, rather than vice versa. Therefore, set priorities on transportation projects with an eye to the land use plan element.

COORDINATE TIMING OF LAND USE AND TRANSPORTATION PROPOSALS



KEY POINTS ABOUT PRIORITIZATION

1. The CIP is rarely new; it usually contains previous year commitments.

2. The projects will be in all stages of development. At any point in time, a project may be stopped temporarily and thrown off schedule.
3. Funding levels and sources may change, or be reallocated to other projects in the BCP. This will affect scheduling and priorities.
4. Priorities may constantly change because of different philosophies, needs, economic conditions, energy availability, or the mission of the base.

Obviously, despite the most careful planning, any number of events may occur to change priorities or force adjustments in the project. The base planner can assist in making sure that any changes that occur are consistent with the base's transportation needs.

It's vital to understand that such changes do not invalidate planning. To the contrary, planning provides the stable foundation on which changes are evaluated and from which new directions begin.

Coordination

The final implementation step in which the planner becomes involved is establishing responsibilities for COORDINATING the projects. For on-base improvements, define the responsibilities among the respective functions such as base civil engineering, security, housing, etc. Also coordinate with civilian agencies responsible for Implementing transportation improvements outside of the base.

Each civilian community prepares a CIP (usually 4, 5, or -years in scope). To the extent possible, the base BCP, and specifically the five-year CIP, should be compatible with these outside projects.

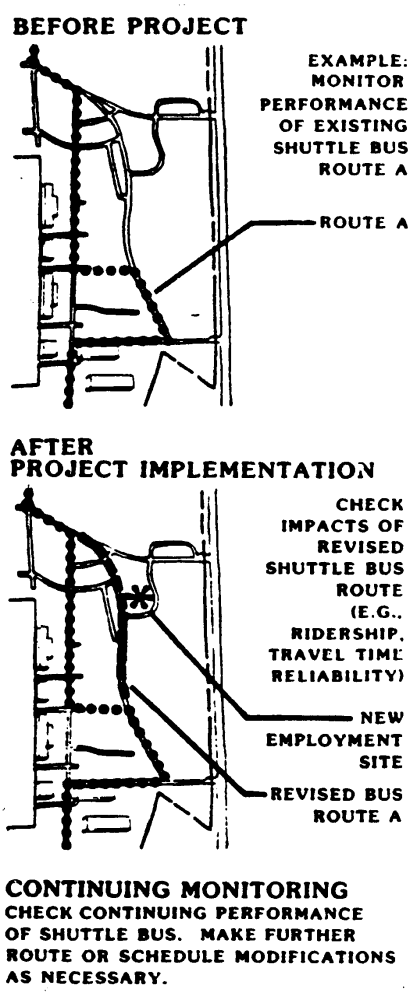
Establish responsibilities for coordination.

GOOD ACCESS TO THE BASE IS CRITICAL TO THE MISSION. Therefore, interact with the appropriate civilian

Coordinate on-base and off-base transportation improvements.

agencies to implement needed improvements to the access road system (see chapter l and AFR 75-88 for the Defense Access Road Program), public bus service, parking, or ridesharing programs. In turn, encourage civilian agencies to prioritize off-base transportation improvements and development proposals to be compatible with land use or transportation changes expected to occur on the base. APPENDIX A provides some examples of community/airbase coordination.

MONITORING



One characteristics of transportation plans is that the analysis performed this year may be obsolete next year. Obsolescence of the transportation plan is inevitable owing to changing missions of the base, revisions to goals and objectives, or changes in funding availability. Therefore, CONTINUALLY MONITOR THE TRANSPORTATION CONDITIONS AND LAND USE CHANGES ON THE BASE, and keep in contact with appropriate civilian agencies.

Monitoring requires checking two features of the project--progress and performance.

Progress Checks

The check of PROGRESS is straightforward, since actual progress can be compared with the scheduled progress shown in the CIP. When monitoring indicates serious slippages in a project's implementation schedule, modify the program as necessary.

Performance Checks

Monitoring of the project's PERFORMANCE requires knowledge of what is expected to occur and knowledge of what is actually occurring. Performance checks can be

DATA COLLECTION FOR PERFORMANCE CHECKS

OPTION 1. COLLECT "BEFORE" DATA AND FORECAST "AFTER" IMPACTS

OPTION 2. COLLECT "AFTER" DATA, WITH RECALL TO OBTAIN SOME "BEFORE" DATA

OPTION 3. COORDINATE "BEFORE" AND "AFTER" DATA COLLECTION

performed in different ways, each of which requires some data collection.

The first technique compares actual data collected before the project was implemented to some forecasts of conditions afterward (see chapter 3 for forecasting). by implication, however, no substantial attempt is made to gather any "after" data to see if the forecasted impacts occurred as predicted.

A second option occurs most frequently when a decision is made, after implementation, to evaluate a project. This after-the-fact decision to evaluate means that adequate "before" data may not be available for comparison purposes. In such cases, the planner may need to recreate the before conditions with less reliable information. However, if a good inventory of base conditions is updated periodically, this type of monitoring will not be difficult.

A coordinated before/after study is recommended. It requires advance planning and occurs most frequently when the project is considered to be a unique, new alternative, and there is a desire to see if it is "successful." The criteria used in the evaluation of alternatives, (see chapter 5) will be a guide to the types of performance impacts to monitor after the project is implemented.

Based on the performance monitoring, the planner may determine that (a) the project is performing as well as or better than expected; or (b) the project is performing worse than expected. In the latter situation, it may be necessary to adjust the design and/or operation of the project. In the extreme case, the planner may need to go back through the planning process to determine if there are major revisions required in forecasting and analysis, or if a different alternative is appropriate.

CONSIDER MONITORING AS A CONTINUING ACTIVITY THAT IS PART OF THE PLANNING PROCESS. To the extent possible, monitor the conditions of the base to make sure that the BCP is still in harmony with actions

TYPES OF PERFORMANCE CHECKS

- CHECK CONGESTION LEVELS AND CHANGES IN SPEEDS OR DELAYS.
- CHECK BUS RIDERSHIP CHANGES
- CHECK USAGE OF A NEW OR MODIFIED PARKING FACILITY.
- CHECK CHANGES IN AVERAGE VEHICLE OCCUPANCIES
- CHECK ACCIDENT RECORDS

being taken in the community. This completes the basic steps in the planning process, although the need for ongoing planning is essential.

APPENDIX A

TRANSPORTATION PLAN OUTLINE

The transportation plan component of the Base Comprehensive Plan (BCP) should contain a complete graphic and narrative description of current and future conditions on the base. The primary graphic requirements are established in the BCP TAB SERIES, documented in AFR 86-4 (Ref. 15). The narrative should provide a verbal description of the transportation plan.

EXHIBIT A-1 shows the suggested outline for a transportation plan. This outline includes the substantive portions of a Statement Of Work (SOW) for the Transportation Plan component of the BCP. It provides greater detail than that provided in Section I of the BCP outline in AFR 86-4 (Ref. 15). Use this outline as the “core” of a SOW or as a guide for preparing the plan using base personnel. Be sure to include other work elements specific to the particular Air Force Base being studied.

APPENDIX A briefly describes each suggested plan component. in the margin is a list of required Tabs, other recommended Tab overlays, and sketch graphics. References are made to appropriate sections of this Bulletin for detailed information on specific plan components Selected Tabs and overlays are used from the Anytown Air Force Base example.

Exhibit A-1. Transportation Plan

Contents		Reference to Bulletin Chapter
1.	Introduction	Chapter 1
2.	Goals and Objectives	Chapter 2
3.	Existing Transportation Conditions	Chapter 2
4.	Problems and Opportunities	Chapter 3
5.	Alternatives	Chapters 3 & 4
6.	Evaluation of Alternatives (criteria, analysis)	Chapter 5
7.	Recommended -Plan (priorities for short-term and long-term)	Chapters 5 & 6

Required Tabs

Tab I-1 - Regional Access to Base (see Exhibit A-2)
Tab I-2 - On-base Network (see Exhibit A-3)
Tab I-3 - Roadway Functional Classification (see Exhibit A-4)
Tab I-4 - Problems and Opportunities (see Exhibit A-5)
Tab I-2.1 - Future Transportation Plan (see Exhibit A-6)
Tab I-3.1 - Future Roadway Functional Classification (see Exhibit A-7)

GRAPHICS:

o TAB I-1 - REGIONAL ACCESS TO BASE

o SKETCH GRAPHICS OF KEY RECOMMENDATIONS

o TABULAR SUMMARY OF NEEDS AND RECOMMENDATIONS

BULLETIN REFERENCE:

o CHAPTER 1

GRAPHICS:

o TABULAR SUMMARY OF GOALS AND OBJECTIVES

BULLETIN REFERENCE:

o CHAPTER 2

GRAPHICS:

o TAB I-2- ON-BASE NETWORK

o TAB I-3 - ROADWAY FUNCTIONAL CLASSIFICATION

o OVERLAYS (OPTIONAL):

- TRAFFIC CONTROL DEVICES
- PARKING
- BUS ROUTES
- PEDESTRIAN AND BICYCLE FACILITIES
- TRAFFIC VOLUMES
- ORIGIN-DESTINATION TRAVEL PATTERNS
- LAND USE (SEE APPENDIX D FOR EXAMPLE)

o REPORT GRAPHICS- DIAGRAMS OF SPECIFIC CHARACTERISTICS (E.G., LOCATIONS OF DELAY. PEAK BUS LOADING POINTS, PARKING LOT DIMENSIONS)

BULLETIN REFERENCE:

o CHAPTER 2

1. INTRODUCTION

The introduction should describe the base location, including access to the base from the surrounding region (Refer to Exhibit A-2). Also include points of contact on base, a summary of the base needs, and highlights of the recommended plan. A person reading only the introduction should be able to understand the primary elements of the plan.

2. GOALS AND OBJECTIVES

List the hierarchy of overall base goals and objectives, clearly showing how the transportation goals and objectives relate to the mission of the base.

3. EXISTING TRANSPORTATION CONDITIONS

Describe current conditions on base, including the following categories:

- Travel Facilities (streets and highways, traffic control devices, bus routes and services, parking, and pedestrian and bicycle facilities)
- Travel characteristics (traffic volumes, bus usage, parking usage, locations of delay, accidents, and origin-destination characteristics)
- Land Use (summary of land use characteristics obtained from land use plan)
- Social and Economic (summary of population and employment characteristics for 6n-base and off-base residents; other relevant information may include duty hours, age, auto ownership, rank, and household size)

The narrative should cover the important aspects in each category, using tables to summarize data In an easy-to-read format and graphics to show specific characteristics. Prepare a Tab 1-2 (see EXHIBIT A-3) showing the on-base network, and a Tab 1-3 (see EXHIBIT A-4) showing the roadway functional classification. Prepare overlays and

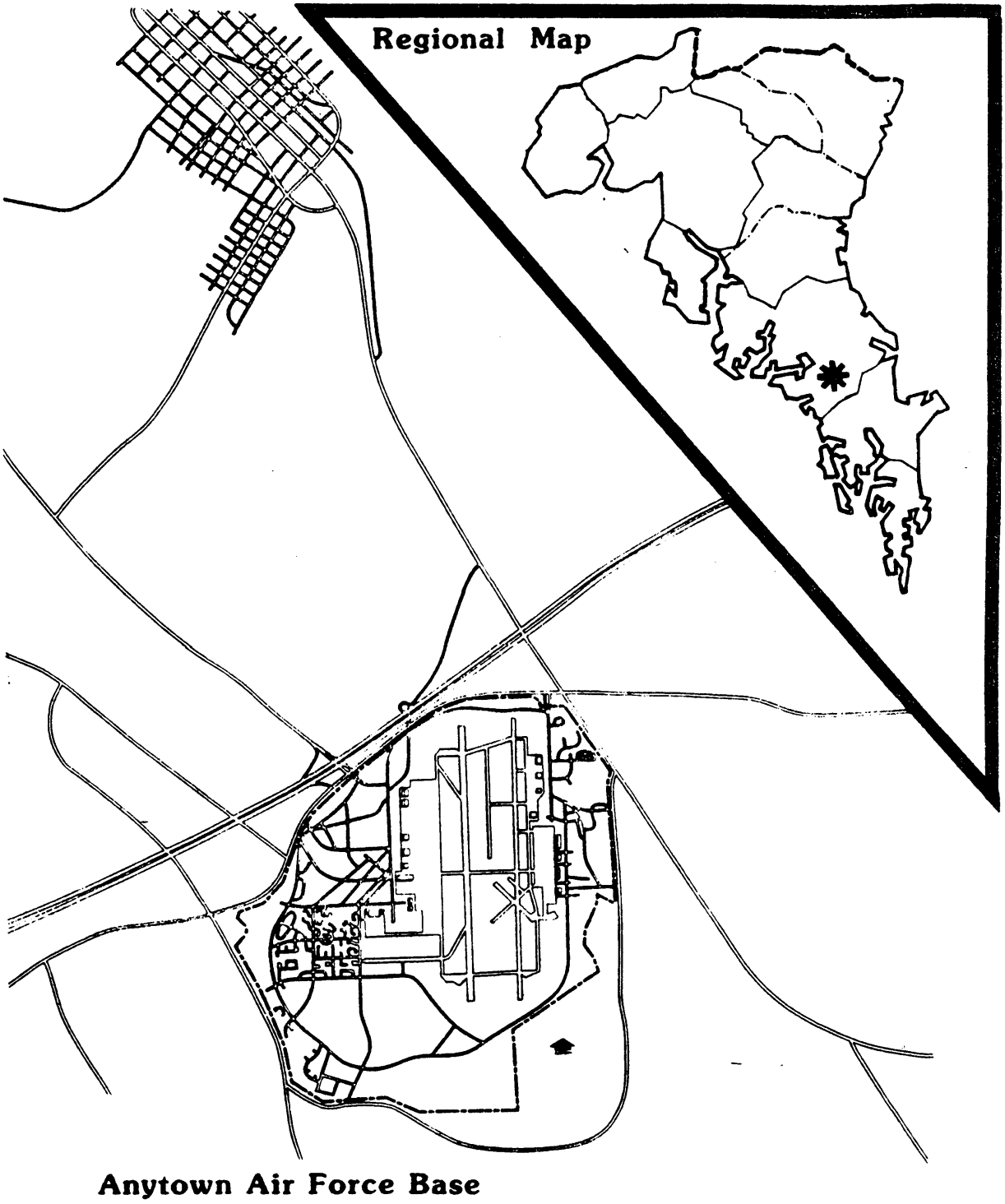


Exhibit A-2. Regional Access to Base

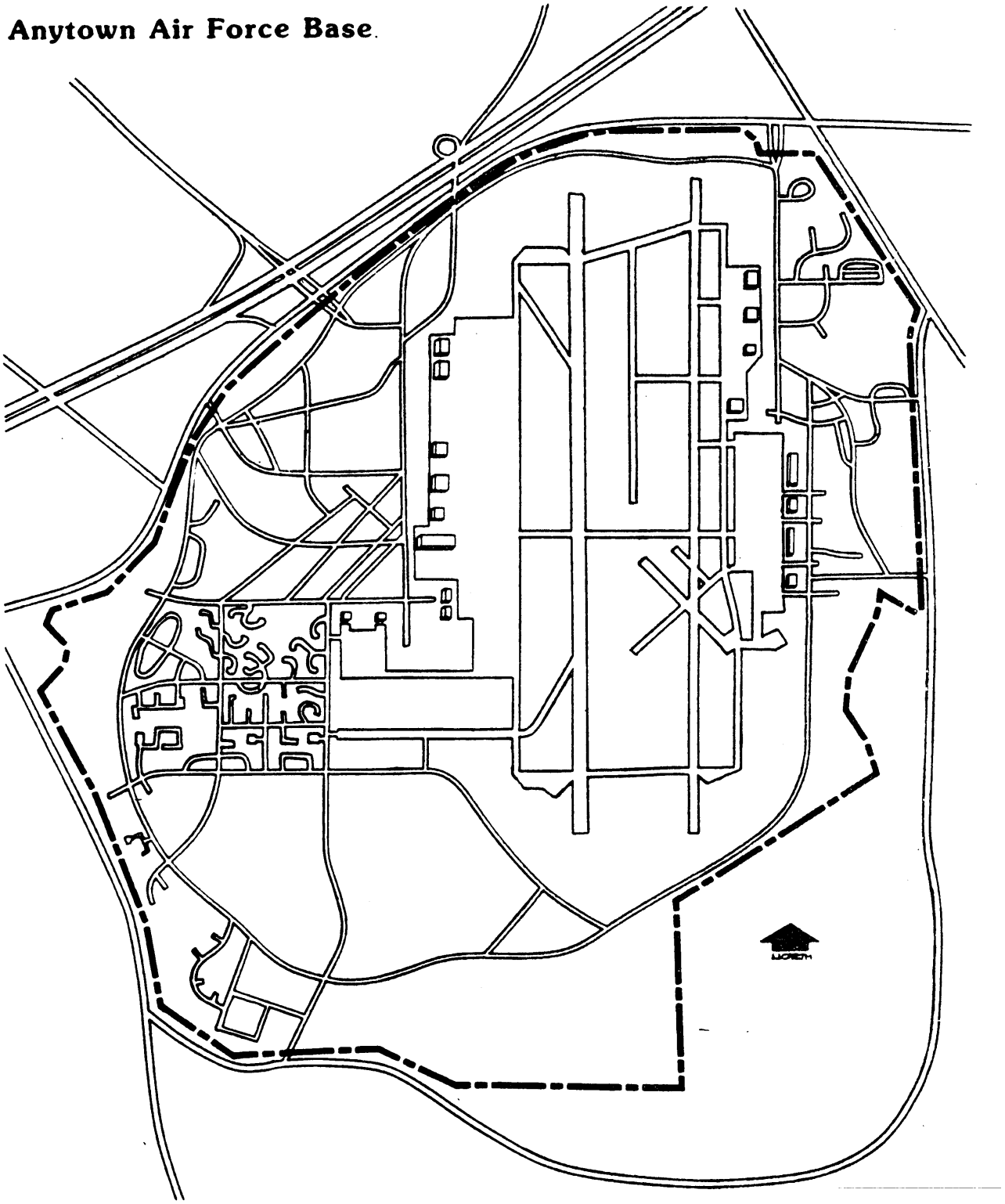


Exhibit A-3. On-base Network

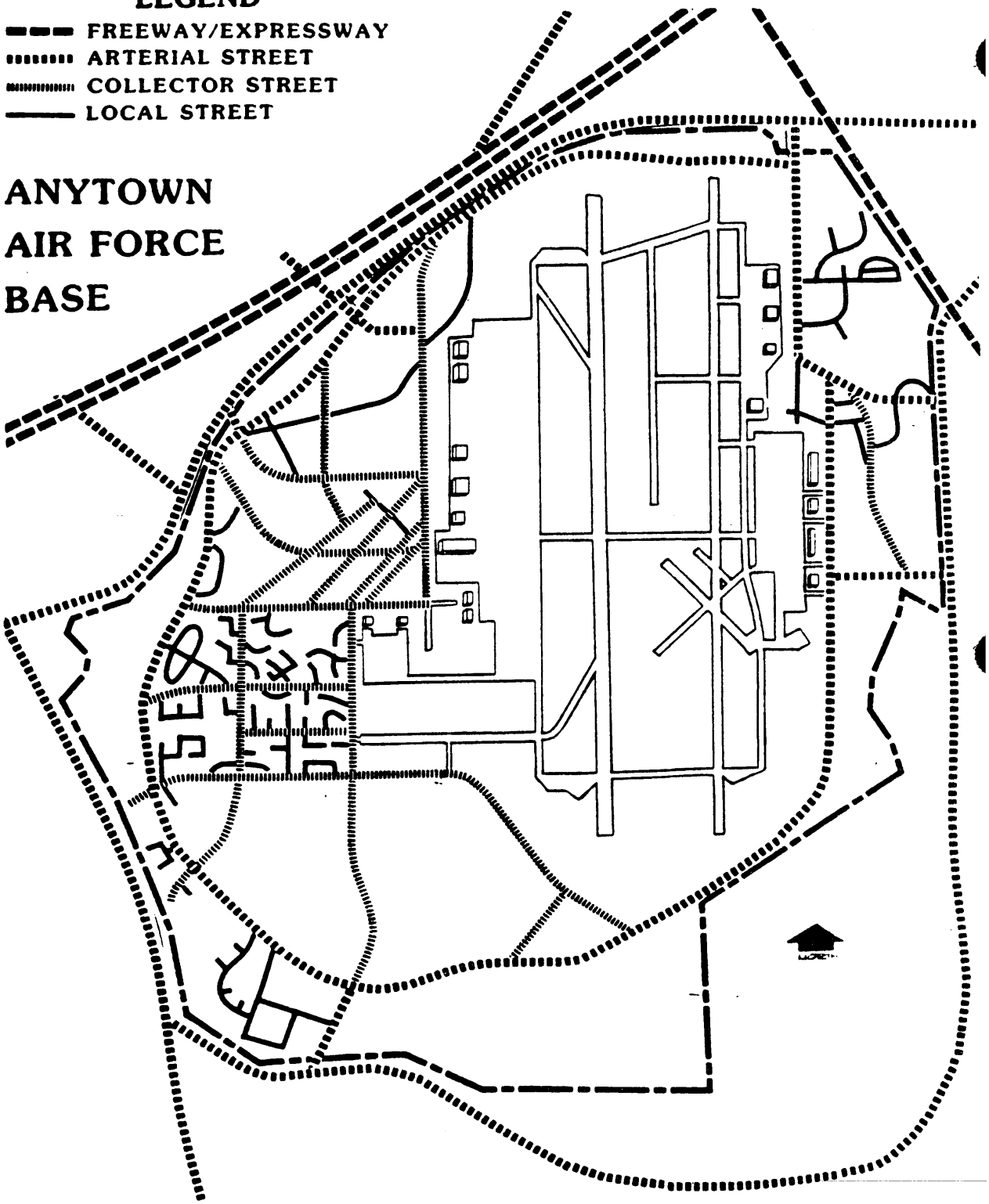


Exhibit A-4. Roadway Functional Classification

o CHAPTER 5

GRAPHICS:

o TAB 1-4 - PROBLEMS AND OPPORTUNITIES

o OVERLAY (OPTIONAL) - FUTURE PROBLEMS

o REPORT GRAPHICS - DIAGRAMS OF SPECIFIC PROBLEMS OR OPPORTUNITIES

BULLETIN REFERENCE:

o CHAPTER 3

GRAPHICS:

o REPORT GRAPHICS - SKETCHES OF ALTERNATIVES

BULLETIN REFERENCE:

o CHAPTER 4

GRAPHICS:

o TABULAR SUMMARIES OF EVALUATION

o TABLE WITH RANKED PROJECTS

BULLETIN REFERENCE:

sketch graphics of other transportation facilities and services as needed to clearly define existing conditions.

4. PROBLEMS AND OPPORTUNITIES

Describe the current problems and opportunities that were identified during the existing conditions inventory. Include a detailed description of what the PROBLEMS are and the probable causes. Also identify existing facilities and services that provide OPPORTUNITIES for improved transportation (e.g., unused taxiway pavement could be used for parking, etc.). Include off-base problems and opportunities to the extent that they will affect planning on the base.

Prepare a Tab I-4 (see EXHIBIT A-5) showing locations of problems and opportunities along with a short narrative of each that is number-keyed to the Tab. Use the results of forecasting to identify potential future problems resulting from land use, transportation, or mission changes. Indicate future problems on the same Tab 1-4 using a different color or symbol, or by means of an overlay.

5. ALTERNATIVES

For each current and future problem/opportunity identified previously, describe the feasible alternatives that were considered. Use a tabular format to clearly display alternatives. Prepare sketches of alternatives, particularly roadway or bus route changes that are otherwise difficult to visualize.

6. EVALUATION OF ALTERNATIVES

Describe the process used to evaluate the alternatives. Include a listing of criteria and standards along with any weightings used for evaluation purposes. Provide tables showing the comparison of alternatives. Conclude with a RANKING of all alternatives.

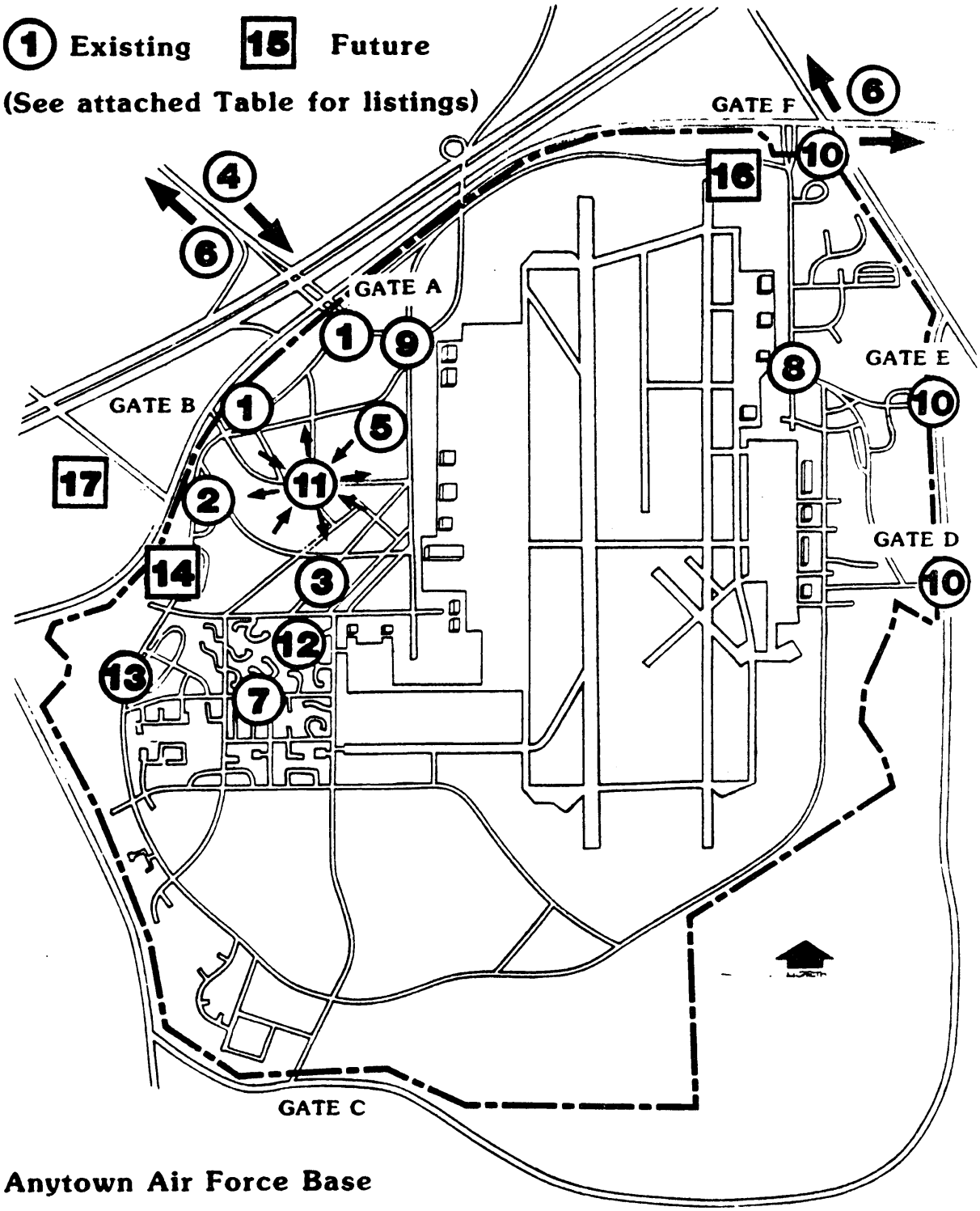


Exhibit A-5. Problems and Opportunities

EXHIBIT A-5. PROBLEMS AND OPPORTUNITIES

EXISTING

1. Congestion At Gate B caused by heavy traffic volumes and lack of storage space.

2. Congestion on Wright Road leading to intersection with Perimeter Road.

3. Inefficient street layout through use of previous runway and taxiway alignments. Creates lack of clear roadway functional classification between gates and flightline.

4. Lack of local or express public bus service to base.

5. New Community Center has inadequate access and parking.

6. Large clusters of off-base housing provide opportunities for ridesharing and bus use.

7. High volumes of through traffic at high speeds through family housing area.

8. Congestion and accident problem at traffic circle.

9. Dogleg intersection creates congestion and accidents.

10. Insufficient traffic demand for Gates D, E, and F. High cost of security to keep all gates open.

11. Duty hours are tightly clustered during 0730 - 1600 hours. Opportunity to create alternative schedules.

12. Lack of good bicycle facilities and pedestrian walkways linking family housing area to administrative and community centers.

13. Perimeter Road along Family Housing area has high accident rate caused by frequent stops and turning vehicles.

FUTURE

14. Expanded medical clinic will create congestion and parking problems.

15. New Air National Guard Support Center will create high traffic and parking demands on east side of base.

16. Redesign of Northwest Freeway (off-base) will improve access to north side of base, but will also create need to redesign Gate F.

17. New industry along Off-base Road will create congestion leading to Gates A and B.

GRAPHICS:

- TAB I-2.1-FUTURE TRANSPORTATION PLAN
- TAB I-3.1 - FUTURE ROADWAY FUNCTIONAL CLASSIFICATION
- REPORT GRAPHICS-DIAGRAMS OF RECOMMENDATIONS; OFF-BASE TRANSPORTATION PROJECTS
- TABULAR SUMMARY OF RECOMMENDATIONS, COSTS, AND IMPLEMENTATION STEPS FOR INCLUSION INTO CIP.

BULLETIN REFERENCE:

- CHAPTERS 5 AND 6

7. RECOMMENDED PLAN

Describe the transportation system required to meet current and future needs. Prepare a Tab 1-2.1 (see EXHIBIT A-6) showing the future transportation plan with short-term and long-term recommendations. Use different colors or symbols to differentiate between short-term and long-term. Include a table describing the recommendations, making sure each is number-keyed to Tab 1-2.1. Also include a Tab 1-3.1 (see EXHIBIT A-7) showing the future functional classification.

Prepare a table showing total cost to implement the short-term and long-term recommendations. For the short-term (five-year) recommendations, prepare yearly cost estimates which will be considered along with other base needs for inclusion into the Capital Improvement Program. An example summary table is shown in EXHIBIT A-8.

Describe steps that should be taken to implement the recommended projects. Include coordination needed among base personnel and off-base agencies.

To the extent possible, also describe known off-base transportation projects that will influence base traffic. For example, Project #22 in Exhibit A-6 involves reconstructing Gate F in response to new interchange construction on the Northwest Freeway outside of Anytown AFB. Provide sketches or fold-out maps to supplement the narrative.

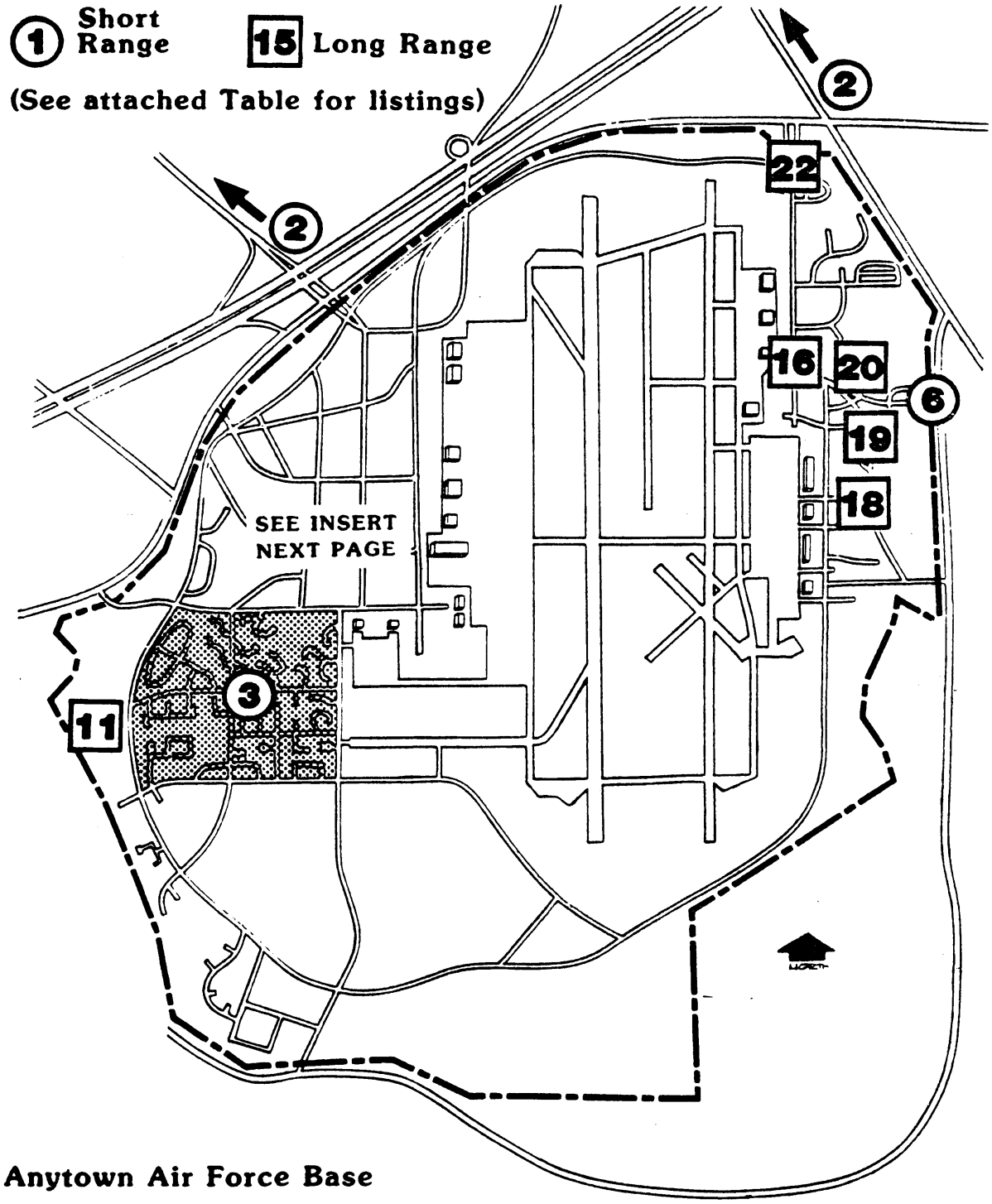
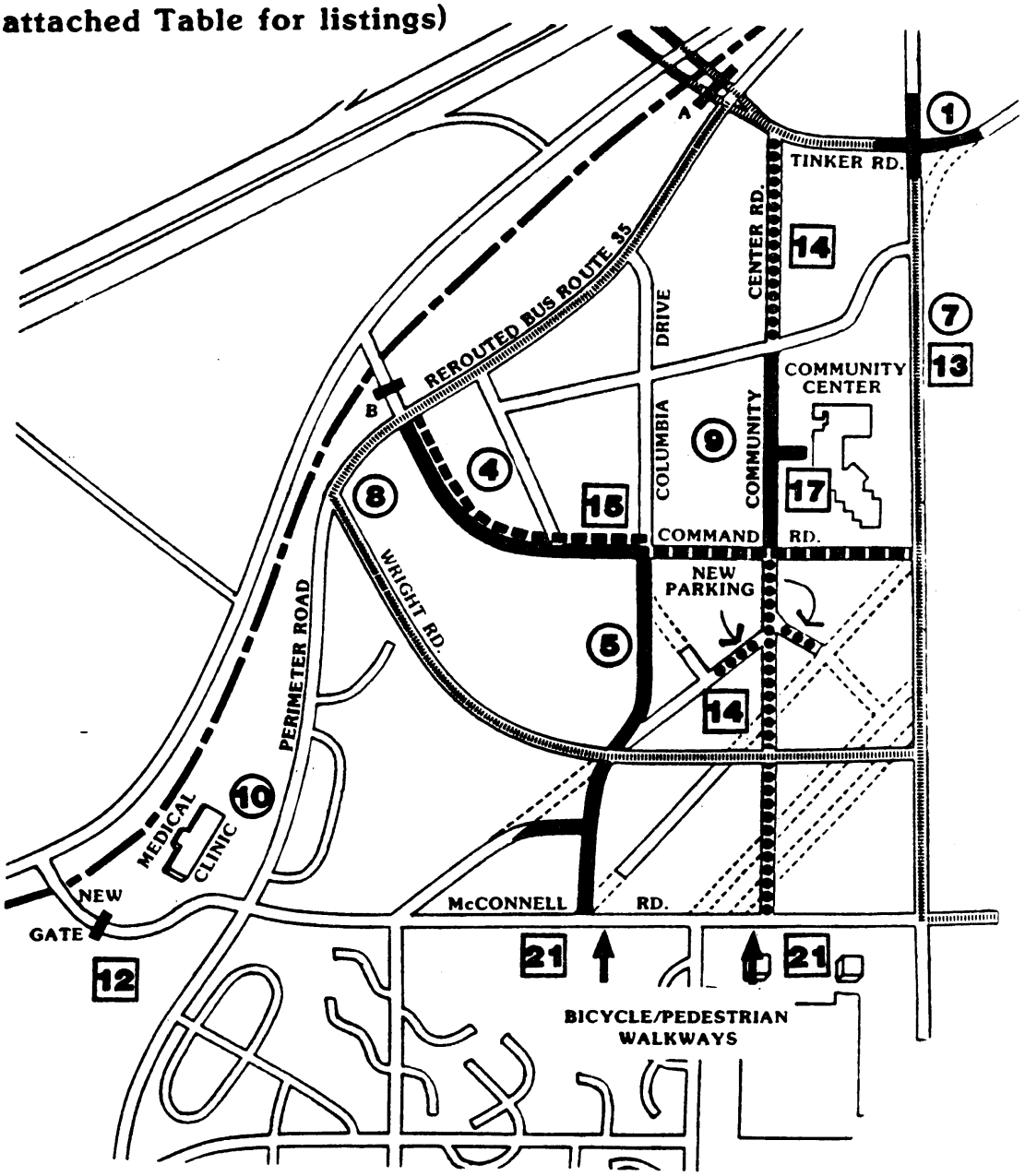


Exhibit A-6. Future Transportation Plan

LEGEND

(1) Short Range [15] Long Range

(See attached Table for listings)



Anytown Air Force Base

Exhibit A-6. Future Transportation Plan

EXHIBIT A-6. FUTURE TRANSPORTATION PLAN

SHORT RANGE (5 YEARS)

1. Redesign intersection to remove dogleg.

2. Coordinate with regional ridesharing agency to promote carpooling and vanpooling to base for work trips.

3. Implement residential traffic controls in family housing area.

4. Implement reversible lanes (3-1) during peak periods on Command Road between Perimeter Road and Columbia Drive.

5. Extend Columbia Drive to McConnell Road. Close sections of old diagonal roads.

6. Change operation at Gate E to operate only during peak hours (0600 - 1800, 1600 - 1800).

7. Work with local transit agency to reroute Bus Route 35 onto base. Make necessary bus stop improvements.

8. Install bus lane on Wright Road approach to Perimeter Road.

9. Construct new road for access to Community Center.

10. Provide new off-street parking for expanded medical clinic.

Basewide: Implement Alternative Work Schedules for non-critical duty hours.

LONG RANGE

11. Widen Perimeter Road to include left turning lanes.

12. Add new gate to serve expanded medical clinic and family housing area. Gate will also help relieve congestion along Off-base Road leading to Gates A and B.

13. Work with local transit agency to implement express bus service to base from off-base housing area.

14. Connect Community Center Road to Tinker Road on the North and to McConnell Road on the South. Remove remnants of old diagonal roads. Convert some to parking.

15. Designate Command Road as an Arterial Street to serve flightline.

16. Redesign intersection. Remove traffic circle and replace with channelized movements.

17. Expand parking lot at Community Center.

18. Reroute Shuttle Bus Route A to serve Air National Guard Support Center.

EXHIBIT A-6. RECOMMENDED PLAN (CONT'D)

19. Consolidate land uses near Air National Guard Support Center. Share parking spaces if possible.

20. Realign intersection next to Air National Guard Support Center.

21. Provide separated bicycle paths and pedestrian walkways linking family ho using area and administrative/community facilities. Coordinate with extensions of Columbia Drive (#5) and Community Center Road (#14).

22. Redesign Gate f to serve new interchange at Northwest Freeway. Work closely with state and local agencies.

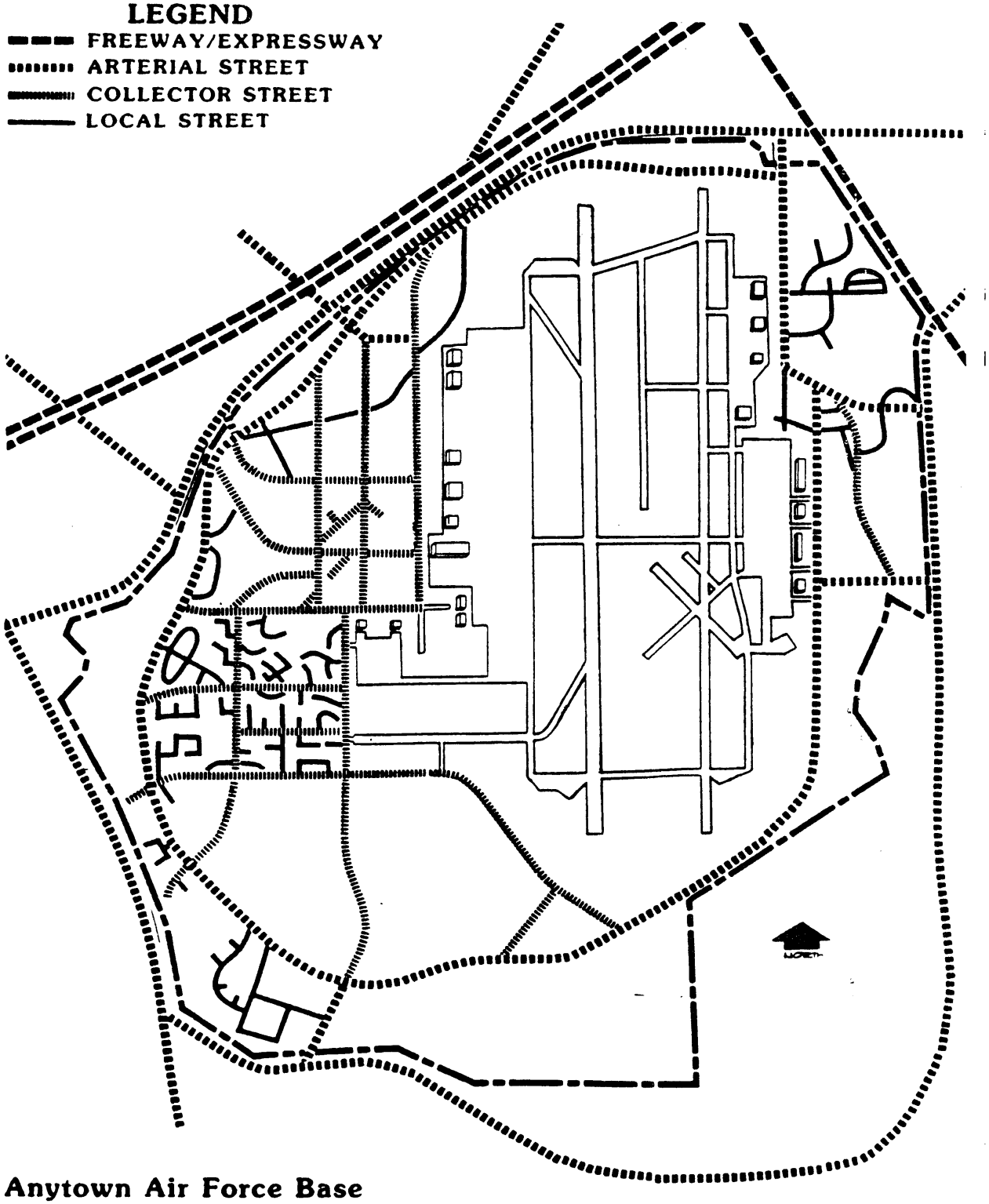


Exhibit A-7. Future Roadway Functional Classification

EXHIBIT A-8
EXAMPLE OF MCP LINE ITEMS IN PRIORITY BY PDP[1]/

BASE: ANYTOWN AFB FY 1987 1 JUL 84

PRI	CAT CODE	TITLE	SCOPE	COST	PGM ELEM
37	851147	Defense Access RD PH 4 Part A	ILS	2100	85796
		FY 1988			
41	851147	Realign-Extend Streets	LS	500	85796
44	851147	Defense Access RD PH 4 Part B	LS	1000	85796
		FY 1990			
17	861147	Street Widening	LS	3000	85796

[1]/ These projects are for illustrative purposes only to show the format for line items. They are not intended to match other projects listed elsewhere in this Appendix. Other MCP projects not listed for each fiscal year are non transportation items.

APPENDIX B

TRAVEL FORECASTING

Travel forecasts are used to determine the transportation service need that will result from a change in land use. For example, forecasts are needed to determine what road improvements may be needed to serve a new housing or employment area. A logical process is used to determine these needs. This Appendix is a supplement to the forecasting section of chapter 3.

MODELS

Forecasting is usually done by means of a model. A MODEL is an abstraction of reality that is used as a means for representing the operation of the real world. The use of a model in forecasting assumes that travel behavior is repetitive and predictable. It further assumes that this behavior can be measured and described, and subsequently used for predicting future habits. Models do not contain the relationships among all the variables that exist, since this would be practically impossible. Instead, the planner abstracts what appear to be the important variables so that reality can be closely recreated by use of the models.

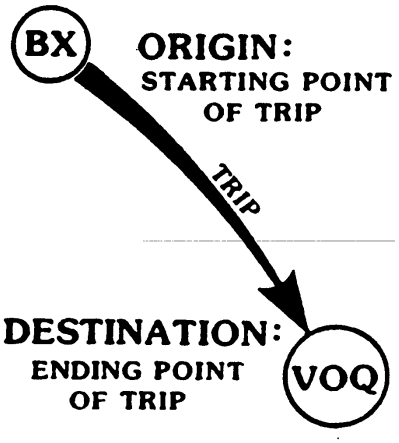
The models may be either simple, manually applied tools or complex computer techniques. Most base planners should use the manual techniques available in the profession. Computer models are typically used by regional agencies and can assist the planner in determining access to the base and other off-base characteristics.

USE OF MODELS

- FORECASTING
- EVALUATING ALTERNATIVE PLANS
- EXPLAINING THE OPERATION OF THE TRANSPORTATION SYSTEM
- MINIMIZING INTUITION AND GUESS WORK

FORECASTING PROCESS

The forecasting process starts with the proposed road network and land use, along with a thorough understanding of existing traffic flow patterns. FORECASTS Of FUTURE TRANSPORTATION CONDITIONS ARE DEPENDENT UPON THE AVAILABILITY OF FUTURE LAND USE LAND USE



PREDICTIONS. Determine future land uses on base by analyzing the current mission and personnel needs and then projecting changes in those needs into the future (Ref. l). The end result is an estimate of future land use characteristics which can be used in performing travel forecasts.

The forecasting models include TRIP GENERATION, TRIP DISTRIBUTION, MODAL SPLIT, AND TRAFFIC ASSIGNMENT. This series of steps is commonly called the "four-step process". A "trip" is defined as a one-way movement from an origin to a destination. Each trip has two ends or termini: the origin and destination. The following sections describe the forecasting process in greater detail.

LAND USE FACTORS

- LOCATION
- CHARACTER
- INTENSITY

Trip Generation

Virtually every new land use will involve a change in traffic volumes and parking needs. The base planner needs to be able to predict those changes in order to establish transportation needs.

TRIP GENERATION analysis is a way to estimate the number of trips that will begin or end at a land use activity. Trip generation analysis provides information on the peak volume of cars to be parked and the peak volume of traffic to be moved onto the road system at any one time.

For analysis purposes, a land use activity or cluster of land uses is called a ZONE The number of trips entering or leaving a zone is dependent on the characteristics of land use in that zone. Three characteristics of land use should be evaluated: LOCATION, CHARACTER, and INTENSITY of activity. Location includes the central and remote areas on base; character Includes the types of land uses, such as housing, administrative, etc.; intensity describes the size of the facility, such as the number of occupants or the number of units.

TRIP GENERATION PERSON TRIPS OR VEHICLE TRIPS

Trips can be divided into different trip PURPOSES, since the trip generation habits of persons differ for different trip purposes. For example, the decision concerning a work trip is much different than that concerning a recreational trip. Typical trip purposes include work, shop, recreation and school.

Trips are generated either as PERSON trips or as VEHICLE trips. PERSON TRIPS are generated PRIOR TO determining the MODE, or method, of travel. The mode split technique, described later in this chapter, divides the person trips into automobile trips, bus trips, and other modes. Person trip generation is most commonly used when there is a large variation in the percentage of bus and other non auto travel.

VEHICLE TRIP generation bypasses the modal split step and gives vehicle trips directly. This latter technique frequently is used for small area planning studies in which modal split can be estimated ahead of time. In most cases, use vehicle trip generation techniques for base planning activities. trips also can be generated by time-of-day (e.g., all day trips, peak hour trips, and peak period trips).

THE KEY TO REDUCING THE COMPLEXITY OF TRIP GENERATION IS TO LIMIT THE FORECAST TO ONLY WHAT IS NEEDED TO ESTABLISH THE MAXIMUM TRAVEL DEMAND. For instance, at an Air Force base maximum travel demand is generally created by the highly directional employee home-to-work vehicle trip that occurs during the morning or evening peak hour.

EXHIBIT B-1 provides an example of-trip generation on Anytown AFB.

Vehicle Trip Generation Rates

The key to trip generation is to establish realistic trip generation RATED Rates can be derived from two sources --counts taken at existing sites similar to the one being

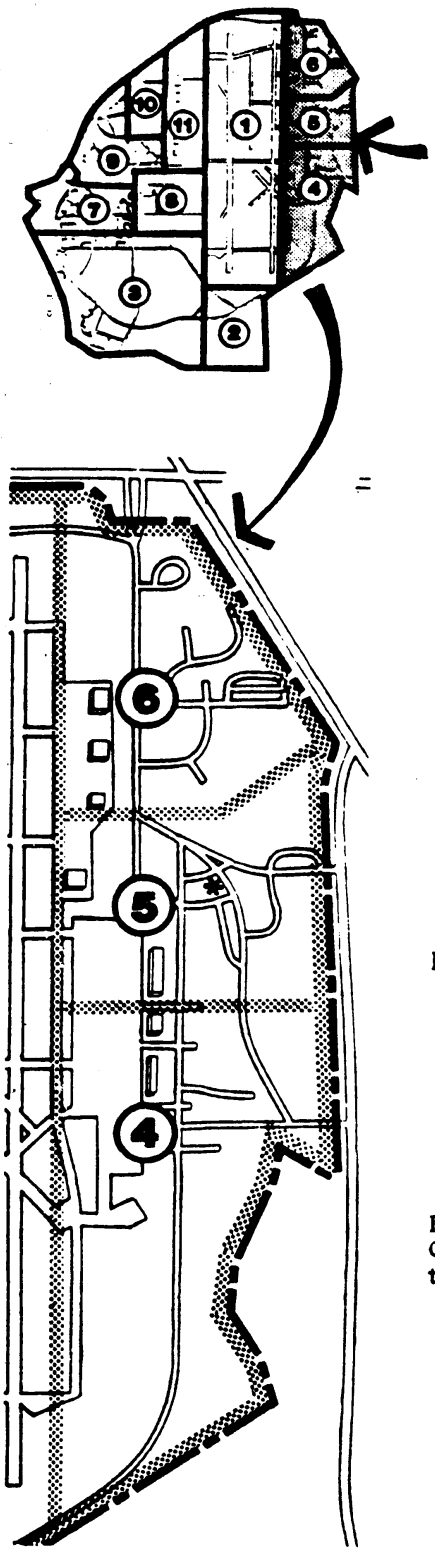


Exhibit B-1. Example of Trip Generation

A. CREATE LAND USE ZONES

B. STATE PROBLEM AND NEED

New Air National Guard Support Center.
Number of Peak Hour Trips?

C. IDENTIFY LAND USE FACTORS
LOCATION - Built Up Area
CHARACTER - Administrative
INTENSITY - 1000 Employees

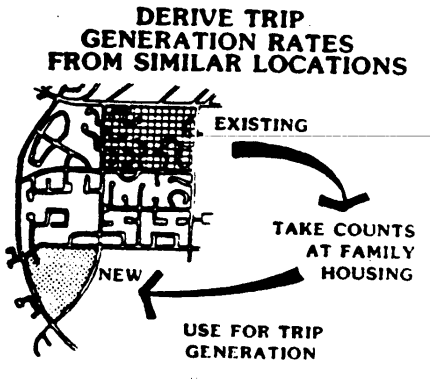
D. DEVELOP TRIP GENERATION RATE

OPTION 1 Traffic Survey at Similar Facility on Base	OPTION 2 Use Rate from Table
• Built-Up Area • Administrative • 400 Employees • Peak-Hour One-Way Vehicle Counts = 180 • Trip Rate = 180/400 = 0.45 Trips/Employee One-Way	• Administrative • Peak Hour Rate (Two-Way) = 0.5 to 0.6 Trip/Emp • Use Average=0.55 • Apply peak hour directional percentage of 85% • 0.55* 0.85 = 0.47 One-Way Trips/Emp
• Other MODES not counted-considered to be minor	

E. APPLY RELATIONSHIP TO FORECAST

PEAK-HOUR ACCESS DEMAND	PEAK-HOUR ACCESS DEMAND
= (1000 Employees) (0.45 Trips/Emp)	= (1000 Employees) 0.47 Trips/Emp)
= 450 Vehicle Trips SELECT	= 470 Vehicle Trips

If data are available, use the OPTION 1 technique. Otherwise, use average values from table (OPTION 2). In this case, the results were very similar for the two options.



studied, and published values using nationwide or regional averages. If at all possible, because of local variations, use the results of actual counts to establish trip generation rates. This is especially true on Air Force Bases, each of which has a unique mission and varying trip characteristics. Take counts at base facilities similar in location, character, and intensity.

For one-of-a-kind uses such a movie theater, Commissary, & BX develop rates from counts taken at those facilities on other bases, keeping in mind that the conditions are not directly transferable. For instance, a BX on one base may cater to a large number of off-base dependents or retired personnel. The trip generation rates obtained at that BX likely will be higher than the rate expected at a BX on a base which has a large family housing area and few off-base dependent or retired users. Knowing these differences, the rates can be adjusted accordingly.

Trip generation rates are expressed in terms of persons or vehicles per unit of land use. Typical units are employees, thousands of square feet of floor space, dwelling units, persons (dormitories), and seats (chapel, cafeteria).

Trip generation rates for civilian land use types are available in many documents, particularly Trip Generation (Ref. 33), published by the Institute of Transportation Engineers, and NCHRP Report No. 187 (Ref. 44). Several of the specific trip generation rates in these reports can be applied to on-base land uses. For example, residential generation rates are given for apartments and single family detached and semi-detached housing, which are housing types prevalent on most bases. Refer to Exhibit B-2 for typical vehicle trip generation rates.

Trip Distribution

Having predicted the number of zonal trips, the planner must then DISTRIBUTE the trips. Trip distributions are analyzed to establish the number of trips that will be made

EXHIBIT B-2
TYPICAL VEHICLE TRIP GENERATION RATES[1/]

BCP Land Categories		24-Hour Avg. Daily Vehicles (two-way)	Peak Hour Vehicles (two-way)	Peak Hour Percentage in peak direction[2/]	Comments
Industrial					
	Aircraft Operations and Maintenance		3 to 4/employee 5 to 6/1000 ft^2	0.4 to 0.7/employee 0.8 to 1.2/1000 ft^2	73%
Administrative					
	General		2.9 to 3.8/ employee 11 to 13/1000 ft^2	0.5 to 0.6/employee 2 to 3/1000 ft^2	85% Higher rates are for smaller offices
Community (Commercial)					
	Shopping clusters		70 to 120/1000 ft^2	6 to 15/1000 ft^2 50%	Higher rate are for smaller shopping centers
	Clubs/dining		2 to 3/seat 75/1000 ft^2	0.1 to 0.2/seat 70% 6 to 10/1000 ft^2	
	Fast food		500/1000 ft^2	30 to 50/1000 ft^2 55%	
	Gas Station		700 to 1000/ station	25 to 30/station 55%	
	Commissary		125/1000 ft^2	10 to 15/1000 ft^2 55%	
	Convenience market Assumes		ft^2	500 to 800/1000	45 to 55/1000 ft^2 50% Open 24 hours
	Indoor recreation (General)		23/employee	N/A N/A	
	Racquet/Tennis		45/court	4 to 5/court N/A	
Community (service)					
	Bank		45 to 50/ employee 170 to 200/1000 ft^2	5 to 9/employee 50% 15 to 35/1000 ft^2	

EXHIBIT B-2
TYPICAL VEHICLE TRIP GENERATION RATES[1/] (Continued)

BCP Land Categories	24-Hour Avg. Daily Vehicles (two-way)	Peak Hour Vehicles (two-way)	Peak Hour Percentage in peak direction[2/]	Comments	
Community (service)					
	School (Elementary)	1/student	16 to 20/emp 0.3/student	3/emp	70%
	Library	51/emp 42/1000 ft^2	4 to 8/emp 3 to 10/1000 ft^2	50%	
Housing (see comment)					
	Single family detached	10/dwelling unit 2.5/person	1.0/dwelling unit 0.25/person	70%	Unaccom-panied housing should use rates per PERSON
	Apartment	6/dwelling unit 2.8/person	0.65/dwelling unit 0.35/person	65%	
	Townhouse/condo - minimum	1.9/person	5.2/dwelling unit 0.20/person	0.45/dwelling unit	70%
	Planned unit development	7.8/dwelling unit	0.75 dwelling unit	70%	
Outdoor recreation					
	General	5 to 6/acre	N/A	N/A	
	Golf course	20 to 30/employee 7/acre	N/A 0.4/acre	N/A 80%	

N/A Not Available.

1/ Source: ITE (Ref. #33)

2/ This peak directional percentage can be multiplied by the peak hour two-way rate in the previous column to estimate one-directional trips. This is important for doing analyses of peak hour traffic conditions.

BETWEEN specific zones. The distributions may change over time with a shift in the bases mission or alert status.

Many mathematical models have been developed to predict distribution of travel. They are generally divided into the GROWTH FACTOR METHODS and PROPORTIONAL DISTRIBUTION METHODS, as described fully in Ref. 28 and 32. Many of these methods require extensive data collection and analyses; therefore, the base planner may need to use outside/contractors for large planning efforts.

Since distance is not crucial within a base, the distribution of on-base trips for a new or expanded land use can usually be done by simply proportioning the trips generated at the land use in relation to existing trip concentrations at other zones on the base. For example, trips generated by a new BX could be distributed to the on-base housing quarters relative to the number of daily trips now generated by each housing area (or zone).

EXHIBIT B-3 provides an example trip distribution for Anytown AFB.

GROWTH FACTOR METHOD

- EXPANDS EXISTING TRIPS USING GROWTH RATE
- TYPES INCLUDE:
  - UNIFORM GROWTH FACTOR
  - AVERAGE GROWTH FACTOR
  - FRATAR METHOD

PROPORTIONAL DISTRIBUTION METHOD

- ESTIMATES TRAVEL PATTERNS BASED ON RELATIVE NUMBER OF TRIPS AND DISTANCES BETWEEN ZONES.
- TYPES INCLUDE:
  - GRAVITY MODEL
  - OPPORTUNITY MODEL

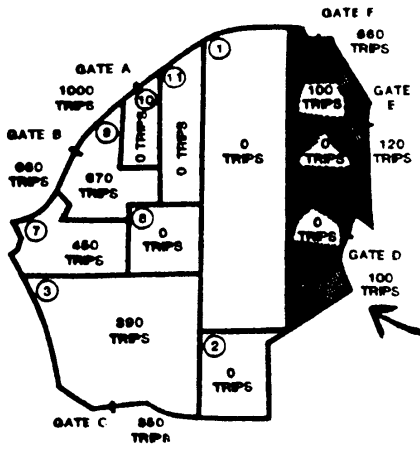
Modal Split

The planner must determine the means, or MODE, of travel of the distributed trips. This analysis is called MODAL SPLIT.

Modal split analysis traditionally considers two modes -- AUTO and BUS. More sophisticated methods consider other modes (or sub-modes) as well including bicycles, pedestrians, motorcycles, and taxis. The auto mode also can be divided into different occupancies, say 1, 2, 3, 4, or 5 or more persons per vehicle.

Several modal split techniques are available. The simplest method is to identify the different modes currently on the base, using volume count data or the results of an origin/destination survey (see Chapter 2). Then apply these splits of modes to trips from new land uses. EXHIBIT B-4

Exhibit B-3. Example of Trip Distribution



A. DETERMINE TRIPS TO BE GENERATED AT NEW WORK SITE

1000 Employees Will Generate 450 One Way Peak Hour Vehicle Trips **(Exhibit B-1)**

B. FROM TRAVEL SURVEYS DETERMINE WHERE EXISTING HOME TO WORK TRIPS ARE DISTRIBUTED

C. DISTRIBUTE FUTURE TRIPS PROPORTIONALLY

EXISTING
Total one-way work trips
=4510
--Originate on-base
=1610
--Originate off-base
=2890

$$T_{ij} = T_j \left(\frac{P_i}{\sum_{i=1}^{n} P_i} \right)$$

T_{ij} = future trips between i and j
T_j = future trips generated at j
P_i = existing trips produced at i
$\sum_{i=1}^{n} P_i$ = total trips produced

THEREFORE:

ON BASE

$$T_{6,5} = T_5 \left(\frac{P_6}{\sum P_i} \right)$$

$= 450 \left(\frac{100}{1610} \right) = 10$ TRIPS

$T_{3,5} = 450 \left(\frac{390}{1610} \right) = 39$ TRIPS

$T_{7,5} = 450 \left(\frac{450}{1610} \right) = 45$ TRIPS

$T_{9,5} = 450 \left(\frac{670}{1610} \right) = 67$ TRIPS

OFF BASE

$T_{A,5} = 450 \left(\frac{1000}{4500} \right) = 100$ TRIPS

$T_{B,5} = 450 \left(\frac{660}{4500} \right) = 66$ TRIPS

$T_{C,5} = 450 \left(\frac{350}{4500} \right) = 35$ TRIPS

$T_{D,5} = 450 \left(\frac{100}{4500} \right) = 10$ TRIPS

$T_{E,5} = 450 \left(\frac{120}{4500} \right) = 12$ TRIPS

$T_{F,5} = 450 \left(\frac{660}{4500} \right) = 66$ TRIPS

CHECK TOTAL = 450 TRIPS

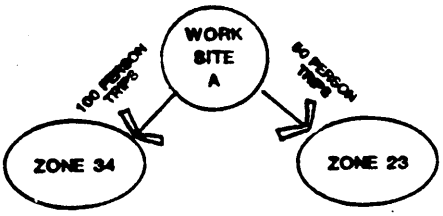
D- MAKE REASONABLENESS CHECKS

As calculated, few trips are oriented to close-by zone 6 and to gates D, E, and F in reality, MORE trips from the new support center would probably use closer gates and housing, area and fewer would go to opposite side of base.
Therefore, adjust volumes using judgment as desired. No adjustments are made in this example.

Exhibit B-4. Modal Split Analyses

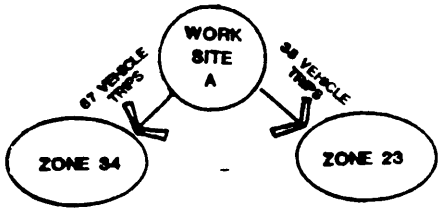
A. TAKE PERSON TRIP DISTRIBUTION RESULTS

B. ESTIMATE MODAL SPLIT (From Origin-Destination Surveys)



	SITE A ZONE 34	SITE A ZONE 23
AUTO	80% = 80	90% = 45
BUS	12% = 12	5% = 2
WALK	5% = 5	3% = 2
BICYCLE	3% = 3	2% = 1
Person Trips	100	50

C. APPLY AUTO VEHICLE OCCUPANCY TO OBTAIN VEHICLE TRIPS (From Existing Vehicle Occupancy Counts)



	SITE A ZONE 35	SITE A ZONE 23
AUTO PERSON TRIPS	80 ÷	45 ÷
AVERAGE VEHICLE OCCUPANCY	1.2 ———	1.2 ———
VEHICLE TRIPS	67	38

TO TRIP ASSIGNMENT

provides a simplified example of a modal split analysis to produce auto vehicle trips from person trips.

More sophisticated modal split methods examine relative travel times or other characteristics which distinguish a person's choice of modes. Typical techniques used in the profession are called regression analysis, diversion curves, and mathematical curve-fitting procedures. These methods, not typically used on Air Force bases, are developed and tested for current conditions, and then are extrapolated into the future.

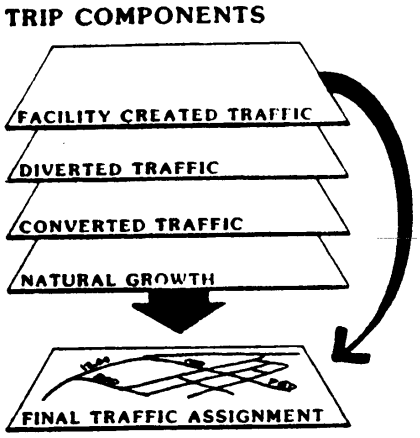
MODAL SPLIT ANALYSIS CAN BE TIME-CONSUMING AND MAY NOT BE A SIGNIFICANT FACTOR ON BASES WHERE THERE IS MINIMAL BUS SERVICE. In such cases a small bus modal split, can be assumed (e.g., less than 5%) in the trip generation analysis, resulting in estimates of vehicle trips generated rather than person trips. This allows the planner to move directly from the trip distribution step to the trip assignment step without a separate modal split analysis.

Trip Assignment

The final phase of forecasting travel demand is the ASSIGNMENT OF TRIPS between zones to various traffic routes. Of primary interest to the base planner is the assignment of automobile traffic, although other vehicle modes (e.g. motorcycles, trucks, bicycles, pedestrians) may also be important for certain planning studies.

The question that naturally arises is, "What are the factors that lead people to choose one route over another?" Generally speaking, researchers have identified at least four: 1) travel times, 2) travel costs, 3) comfort, and 4) levels of congestion. Of these, travel time is the most important factor in route choice.

There are four major components of assigned traffic that must be considered:



TRAFFIC ASSIGNMENTS

- **All-or-Nothing**
- **Capacity Restraint**

Facility-Created Traffic - traffic developed because of changes in land use

Diverted Traffic - existing trips diverted from other paths

Converted Traffic - trips created by change in mode such as bus to auto or carpool to driver

Natural Growth Traffic - result of natural growth rate

Since each component has different characteristics, perform separate traffic assignments and then add the numbers together to produce a total assignment. In many cases, the diverted and converted traffic components can be omitted without a great loss in accuracy.

A variety of trip assignments procedures are available, ranging from manual techniques to sophisticated computer models. The simplest method of traffic assignment is to assign all of the traffic to the highway system based on a single calculation of minimum time (i.e., "best") routes. This is called an "ALL OR NOTHING" assignment and can often be used for small area studies on the base.

Other procedures try to be more realistic by assigning most of the traffic to the "best" route and the rest of the traffic to "next best" routes. This technique, called a CAPACITY RESTRAINT model, considers that vehicle speeds (and time) vary in relation to the amount of traffic on a road. A portion of the traffic is first assigned to the minimum time paths, but as more congestion occurs, the assumed speed on the roadway sections is decreased, thereby making it less attractive to motorists. As more traffic is assigned, new "shortest time" paths are revealed, resulting in a revised traffic assignment. This process is repeated in a trial-and-error fashion until traffic is balanced on all routes between zones.

EXHIBIT B-5 provides an example of a traffic-restraint assignment for Anytown AFB. This example includes two repetitions whereby new travel times are computed for alternative paths after the trips are assigned.

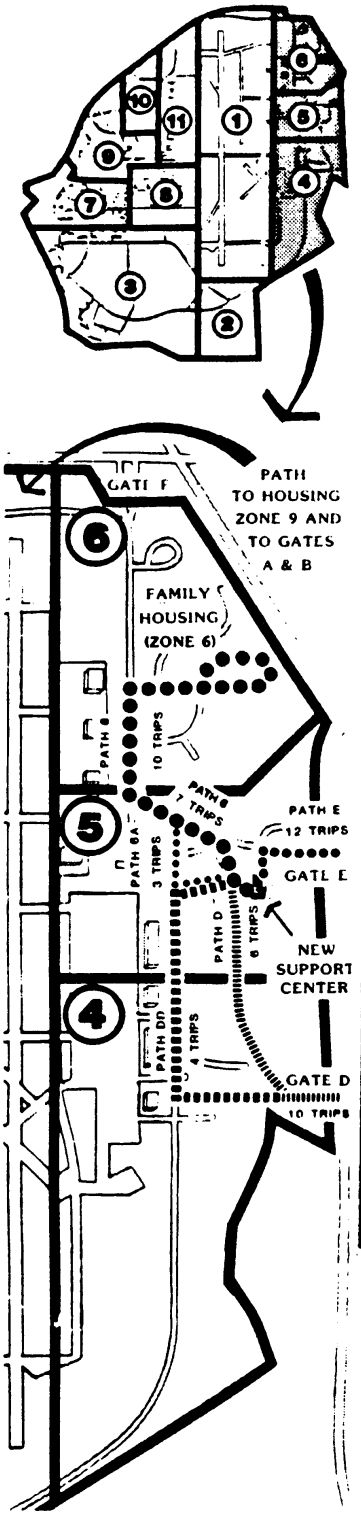


Exhibit B-5. Traffic Assignment

A. LIST TRIP MOVEMENTS BETWEEN ZONES FROM TRIP DISTRIBUTION (USING EXAMPLE TO ZONE 6 HOUSING AND TO GATES D AND E)

B. ESTABLISH AN ASSIGNMENT ROAD NETWORK

C. CALCULATE MINIMUM PATHS BASED ON TRAVEL TIME WITHOUT ASSIGNED TRIPS.

1ST TRY	2ND TRY
PATH D	PATH D
	PATH DD
PATH E	PATH E (NO ALTERNATIVE)
PATH 6	PATH 6
	PATH 6A

D. ASSIGN TRIPS TO MINIMUM PATHS

1ST TRY	2ND TRY
PATH D = 10 TRIPS	PATH D 6 TRIPS
	PATH DD 4 TRIPS
PATH E = 12 TRIPS	PATH E 12 TRIPS
PATH 6 = 10 TRIPS	PATH 6 7 TRIPS
	PATH 6A 3 TRIPS

E. ADD TRIPS TO OTHER TRIP COMPONENTS (NATURAL GROWTH, DIVERTED, CONVERTED)

F. COMPUTE NEW TRAVEL TIMES

	1ST TRY		2ND TRY	
	BEFORE	AFTER	BEFORE	AFTER
	(MINUTES)		(MINUTES)	
PATH D	10	15	15	13
PATH DD	12	12	12	13
PATH E	3	3	3	3
PATH 6	8	12	12	11
PATH 6A	10	10	10	11

NOTES: PATHS D AND 6 ARE NO LONGER MINIMUM TIME

NOTES: ALL PATHS EQUAL FOR TRIPS

TRY AGAIN

G. ANSWER REACHED

BE SURE TO INCLUDE ALL TRIP COMPONENTS ON ROADWAY, NOT JUST FACILITY-CREATED. USE SAME TECHNIQUE FOR ASSIGNMENT OF NEW FACILITY TRIPS TO OTHER ZONES AND GATES.

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Complicated base planning efforts and those which require off-base analysis will likely need to use some form of capacity restrained assignment process, often done on a computer. Otherwise, imbalanced traffic flows will result.

CHECKS ON RESULTS

- **CHECK ON RESULTS**
- **ESTABLISH ACCURACY AND REASONABLENESS**

The results of the forecasting process must be checked for accuracy and reasonableness. Common sense should be used to determine if the trips forecasted into the future are "in-scale" with the current trips; if not, adjustments must be made.

The following checks are described in more detail in NCHRP Report No. 225 (Ref. 39):

- Check 1 - Examine Land-Use Data - This check should actually be done before trip generation is performed. Make sure that future land uses are consistent in size and location with existing land uses.
- Check 2 - Compare Trips Generated to Land Use - After the trip generation step, check to make sure that the numbers of future trips estimated for each zone are reasonable compared with existing trips.
- Check 3 - Examine Road Network - Check the road network onto which the trips will be assigned to make sure that the travel times assumed for each roadway segment are reasonable compared with adjacent segments. If not, the traffic assignment will cause some routes to have too many trips and other routes too few trips.
- Check 4 - Compare Growth Trends - Test the reasonableness of the forecasted traffic growth compared with historical trends. Sources of historical trends include population and employment changes on/off the base and changes in housing units over time. The intent is to make sure that there is a logical explanation for any differences in growth

between current and future conditions compared with the historical trends.

By using these checks, which usually can be performed quickly, the planner can have confidence in the forecasts. Also, any necessary changes can be made before proceeding too far into the plan.

COMPUTER FORECASTING

Travel demand forecasting has become increasingly oriented to COMPUTERS in the past few years. Many urban areas surrounding Air Force bases now perform the forecasting process using computer programs available from the United States Department of Transportation (USDOT). Although few planning studies on the base would use these complex programs, it is important for the planner to be familiar with these capabilities. In most cases the base will be part of a regional computer network, and the local agency will include the base roads and traffic in the regional forecasts. Consultants hired for planning work would frequently use computerized forecasting techniques.

The most widely used computer package for main-frame computers is called the Urban Transportation Planning System (UTPS). The UTPS computer programs, described in Ref. 40, cover transit (bus and rail) and highway demand analysis. UTPS usually is used to test different roadway or transit alternatives relative to traffic congestion, bus ridership, air pollution, energy use, and other factors. For instance, in order to determine how best to reduce congestion on a certain road, UTPS can be used to examine alternatives such as adding lanes, building a new road, or relocating a proposed building. Various maps, tables, and graphs can be produced to display results.

Recently, several portions of the UTPS process have been developed for use on microcomputers. These programs are available either through USDOT or through numerous

APPLICATIONS OF URBAN TRANSPORTATION PLANNING SYSTEM (UTPS)

- FUTURE TRANSPORTATION ALTERNATIVES
- PARKING NEEDS
- BUS RIDERSHIP AND OPERATING COSTS
- BUS REROUTING

private vendors. The USDOT compiles an updated listing of microcomputer software in both the public and private domain. The software, Including computer graphics, should be very compatible with the planning needs on Air Force bases.

APPENDIX C

APPENDIX C
EVALUATION TECHNIQUES

The process described in Chapter 5 includes optional techniques for conducting an evaluation. This Appendix describes three techniques - judgment, cost-effectiveness analysis, and benefit-cost analysis in greater detail.

CRITERIA

Any evaluation technique must be capable of comparing the alternatives against the transportation goals and objectives. The specific means of comparison are called criteria. These criteria may be very simple or quite detailed, but in all cases should be measurable either with a quantitative number or a subjective statement (e.g., minimal, good, poor). EXHIBIT C-1 lists criteria for various types of transportation objectives. An example is shown in the margin.

1. IDENTIFY OBJECTIVE

EXAMPLE: MINIMIZE TRAVEL TIME

2. SELECT CRITERIA

- o POINT-TO-POINT TRAVEL TIME
- o VEHICLE DELAY

3. SET STANDARDS

- o MAXIMUM 10-MINUTE TRIP BETWEEN ANY ON-BASE HOUSING AND COMMUNITY CENTER
- o MAXIMUM 60 SECONDS/VEHICLE DELAY AT INTERSECTIONS

JUDGMENT

The simplest method of evaluation is to briefly examine the impacts of each alternative and make a decision using JUDGMENT. In reality, the selection may be a command decision made for military rather than technical reasons. Similarly, judgment decisions might occur earlier in the process, flavoring the selection of alternatives brought to the commander for decision. The weakness of a pure judgment approach is that it increases the chance for human error and may result in a poorer alternative being selected.

COST-EFFECTIVENESS ANALYSIS

COST-EFFECTIVENESS ANALYSIS is a method used to analyze the consequences of a transportation alternative in

COST-EFFECTIVENESS ANALYSIS

EITHER:

- o PROVIDE ALL INFORMATION (METHOD #1)

OR:

- o REFINE DATA INTO A COMPOSITE SCORE (METHOD #2)

EXHIBIT C-1 CRITERIA

Objective: Minimize Travel Time
- Person-Hours of Travel (PHT)
- Point-to-Point Travel Time
- Response Time
- Vehicle Delay
- Vehicle-Hours of Travel (VHT)
- Vehicle Stops

Objective: Minimize Travel Costs
- Parking Cost
- Point-to-Point Out-of-Pocket Travel Costs
- Point-to-Point Bus Fares

Objective: Maximize Safety
- Accidents
- Accident Rate
- Traffic Violations

Objective: Maximize Security
- Crimes

Objective: Maximize Comfort and Convenience
- Frequency of Bus Service
- Hours of Bus Operation
- Parking Accumulation
- Comfort & Convenience
- Transfers per Passenger
- Bus Load Factor
- Bus Transfer Time
- Trip Distance
- Walking Distance from Parking Location to Destination

Objective: Maximize Reliability
- Perceived Reliability of Bus Service
- Schedule Adherence
- Bus Vehicle Breakdowns
- Vanance of Average Point-to-Point Travel Time

Objective: Maximize Auto Usage
- Intersection Vehicle Turning Movements
- Number of Car Pools
- Number of Vehicles by Occupancy
- Person-Miles of Travel (PMT)
- Person Trips
- Traffic Volume
- Vehicle-Miles of Travel

Objective: Maximize Bus Usage
- Information Requests
- Passenger Miles of Travel
- Bus Passengers

Objective: Maximize Pedestrian and Bicycle Travel
- Bicycle Counts
- Pedestrian Counts

Objective: Maximize Capacity
- Critical Lane Volume
- Level of Service
- Parking Supply
- Volume/Capacity Ratio

Objective: Maximize Productivity
- Active Bus Vehicles
- Bus Operating Cost per Passenger Trip
- Bus Operating Cost per Revenue Vehicle-Mile
- Bus Operating Revenue/Operating Costs
- Passengers per Revenue Vehicle-Hour
- Passengers per Revenue Vehicle-Mile

Objective: Minimize Operating Costs
- Operating and Maintenance Costs
- Operating Deficits
- Operating Revenue

Objective: Minimize Capital Costs
- Capital Cost

Objective: Minimize Noise Impacts
- Noise Levels

Objective: Minimize Air Pollution
- Concentration of Pollutants
- Tons of Emissions

Objective: Minimize Energy Consumption
- Energy Consumption

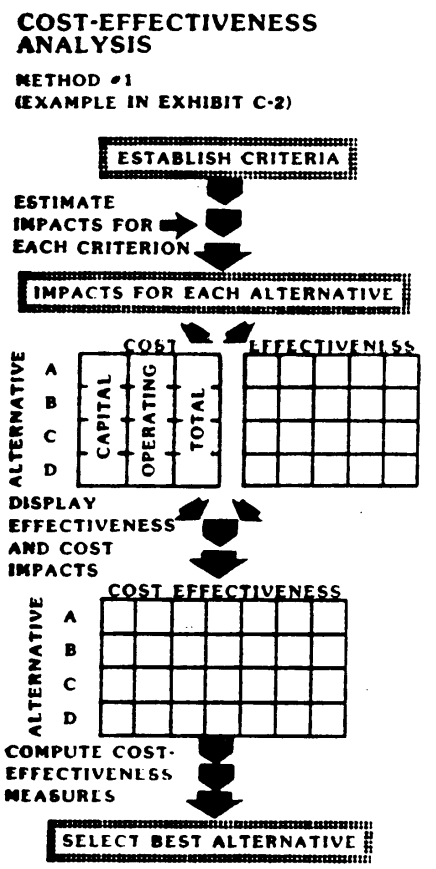
Objective: Maximize Transportation Disadvantaged Ridership
- Transportation Disadvantage Ridership

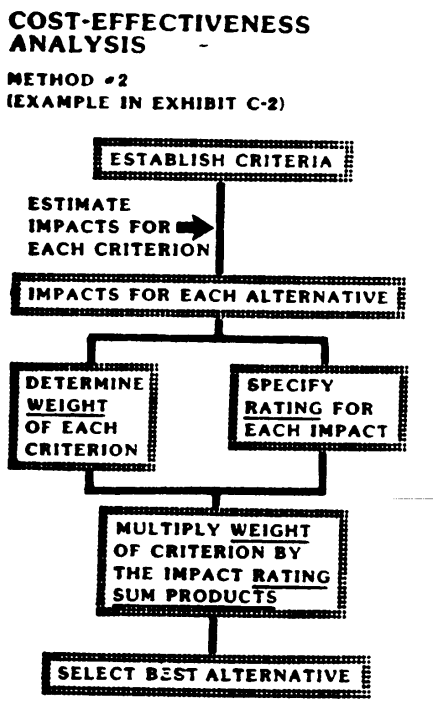
Objective: Minimize Economic Impacts
- Dollar Sales
- Employment

Objective: Maximize Equity
- Point-to-Point Travel Costs to Major Activity Centers
- Point-to-Point Travel Time to Major Activity Centers
- Population within ¼-mile of Bus Route

Objective: Minimize Displacement
- Acres of Lane Acquired
- Structures Displaced

Source: Ref. 23





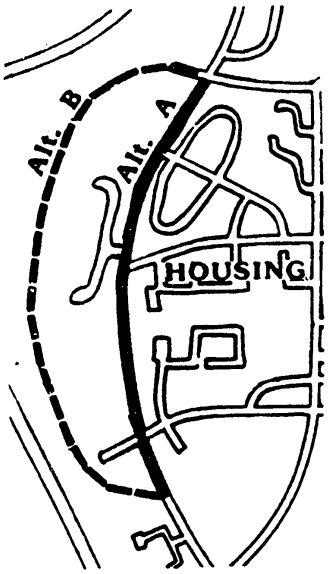
terms of the results produced and the resources required to produce those results. Cost-effectiveness techniques generally can be divided into two groups: methods which attempt to present as much information as possible and methods which attempt to organize and refine the data into a composite rating, or score. EXHIBIT C-2 provides an example.

Method #1 - The first method provides the decision-maker with the entire array of information. It avoids any possibility of masking any weaknesses in the project characteristics. However, the drawback to the method is the confusion that may result from the presentation of too much data.

TO CONDUCT THE EVALUATION, DIVIDE THE IMPACTS INTO EFFECTIVENESS AND COST IMPACTS. Next, display these impacts in a table or matrix to permit easy understanding. This will permit the persons doing the evaluation to look at TRADE-OFFS among alternatives. Also compare the levels of effectiveness against the costs, such as "cost per travel time saved" or "cost per gallon of fuel saved." Finally, an alternative may be rated lower or eliminated from consideration for failure to meet the standard set for a particular criterion.

Method #2 - The second cost-effectiveness method attempts to distill the impacts into a single value that represents the "worth" of the project. In so doing, an alternative can be ranked on the basis of how it's index number compares with those of other alternatives. with this method, there is little chance of confusion because all characteristics are presumably represented by one factor. One drawback is that the use of a composite value may conceal items of special interest to the decision-makers. Also, the factors used to produce the index number are subject to personal opinion, producing biased results.

EXHIBIT C-2. COST-EFFECTIVENESS ANALYSIS



PROBLEM: CONGESTION AND ACCIDENTS ON PERIMETER ROAD
TASK: SELECT BEST ROADWAY ALTERNATIVE
ALT A - WIDEN EXISTING PERIMETER ROAD
ALT B - CONSTRUCT BYPASS ROAD

A. ESTABLISH CRITERIA — **B. ESTIMATE IMPACTS FOR EACH CRITERION**

	ALT A	ALT B
Accident Change	- 2/Year	- 4/Year
Travel Time Change	- 3 Min.	- 5 Min.
Travel Distance Change	0 Mi.	+0.2 Mi.
Exposure to Pollution	No Change	Improved
Cost (Capital)	$100,000	$1,500,000

Both Methods #1 and #2

Method #2 Only

C. DETERMINE WEIGHT OF EACH CRITERION

CRITERIA	WEIGHT
Cost	4
Accident	4
Travel Time	3
Exposure to pollution	2
Travel distance	1

2

D. SPECIFY RELATIVE PERFORMANCE OF EACH ALTERNATIVE IN EACH CATEGORY

CRITERIA	PERFORMANCE RATING ALT A	ALT B
Cost	5	1
Accident rate	3	4
Travel time	3	5
Exposure to pollution	2	3
Travel distance	4	1

2

E. MULTIPLY THE WEIGHT OF EACH CRITERION BY THE PERFORMANCE RATING THEN SUM PRODUCTS

CRITERIA	Weight X Performance = Product ALT A RATING	ALT B RATING
Cost	4 x 5 = 20	4 x 1 = 4
Accident rate	4 x 3 = 12	4 x 4 = 16
Travel time	3 x 3 = 9	3 x 5 = 15
Exposure to pollution	2 x 2 = 4	2 x 3 = 6
Travel distance	1 x 4 = 4	1 x 1 = 1
TOTAL	49	42

F. SELECT PLAN WITH HIGHEST SCORE

ALT A

Method #2

Method #1 Only

C. COMPUTE COST EFFECTIVENESS MEASURES

	ALT A	ALT B
$/Accident change	$50,000	$375,000
$/Travel time change	$33,300	$100,000
$/Travel distance change	infinity	worse condition

1

D. REVIEW ALL DATA AND MAKE SELECTION

ALT A = BEST PLAN

. Slightly Less Effective
. Much Lower Cost

> Better Cost Effectiveness

Method #1

To use this method, apply a weight to each criterion and a performance rating to each impact, including cost. Once this is done, multiply the weights and the ratings, summed for all criteria, to produce a combined effectiveness index, or score, for an alternative. Finally, rank the alternatives on the basis of their scores.

BENEFIT-COST ANALYSIS

BENEFIT-COST ANALYSIS IDENTIFIES THE HIGH PAYOFF ALTERNATIVES

Benefit-cost (B/C) analysis is used to identify the ;"high payoff" alternatives,. that is, those that provide the most benefits compared with the cost of the project. Formal B/C analysis is usually out of the scope of most base planning activities; however, the planner should be familiar with the basic methodology should the need arise for large projects or through work with a consultant. First, convert the impacts into a dollar value (benefit), which represents USER COST SAVINGS relative to a "do-nothing" condition. Next, sum these benefits and compare the total with the cost to achieve those benefits. Through the use of interest rates and/or inflation, compare costs and benefits over different time periods.

Six methods of benefit-cost analysis typically are used: equivalent uniform annual cost, present worth, equivalent uniform annual net return, net present value, benefit-cost ratio, and rate of return. The definition of these methods can be obtained from the basic texts in the field of engineering economy such as a Manual on User Benefit Analysis of Highway and Bus Transit Improvements (Ref. 26).

EXHIBIT C-3 gives a simple example of net present value analysis for two alternative projects. Alternative A has higher capital costs and benefits but lower operations and maintenance costs than alternative B. A ten-year

TYPES OF BENEFITS

- USER TIME SAVINGS
- VEHICLE OPERATIONS AND MAINTENANCE COST SAVINGS
- ACCIDENT BENEFITS

EXHIBIT C-3. BENEFIT-COST ANALYSIS

Year	Single Amount Present Worth Factor (@5%)	Alternative A ($Millions)				Alternative B ($Millions)			
		Benefits	Costs	Present Value of Benefits	Costs	Benefits	Costs	Present Value of Benefits	Costs
0	1.0000	-	50	-	50	-	8	-	8
1	0.9524	10	2	9.5240	1.9048	4	2.5	3.8096	2.3810
2	0.9070	12	2	10.8840	1.8140	5	2.5	4.5350	2.2675
3	0.8638	14	2	12.0932	1.7276	6	2.5	5.1828	2.1595
4	0.8227	16	2	13.1632	1.6454	7	2.5	5.7589	2.0568
5	0.7835	16	2	12.5360	1.5670	7	2.5	5.4845	1.9587
6	0.7462	16	2	11.9392	1.4924	7	2.5	5.2234	1.8655
7	0.7107	16	2	11.3712	1.4214	7	2.5	4.9749	1.7768
8	0.6768	16	2	10.8288	1.3536	7	2.5	4.7376	1.6920
9	0.6446	16	2	10.3136	1.2892	7	2.5	4.5122	1.6115
10	0.6139	16	2	9.8224	1.2278	7	2.5	4.2973	1.5348
			Total	112.48	65.44		Total	48.52	27.30

Net Present Value = 47.04
(Benefit - Cost)

$\frac{\text{Benefit}}{\text{Cost}} = 1.72$

Net Present Value = 21.22
(Benefit - Cost)

$\frac{\text{Benefit}}{\text{Cost}} = 1.78$

analysis period and a 5 percent discount factor are used in the example. All costs and benefits are stated in year 0 constant dollars. The results of this analysis show that alternative A has a substantially higher NET PRESENT VALUE but alternative B has a slightly better BENEFIT/COST RATIO.

All B/C analyses fail to adequately consider NON-USER costs and benefits, those impacts which do not have a dollar value directly associated with them. Examples include the value placed on the visual impact of a roadway, on the comfort of a bus ride, on budgetary considerations, or on institutional feasibility. The inability to fully consider these "social costs" can bias the results of a B/C analysis, although this should not be a major problem for evaluating the types of projects common to Air Force bases.

APPENDIX D

- EXHIBIT D-1. ORIGIN-DESTINATION QUESTIONNAIRE (CHAPTER 2)
- EXHIBIT D-2. BCP LAND USE CATEGORIES (CHAPTER 2)
- EXHIBIT D-3. AIR FORCE PARKING STANDARDS (CHAPTER 4)

ORIGIN AND DESTINATION QUESTIONNAIRE

Do not write in space below.

Your cooperation in this survey will aid in improving traffic conditions on this Base. If you drove a vehicle to work today, please answer all questions. If you were a car passenger, walked, came by a public transit, or came by any other means, answer only Part A.

Circle the number corresponding to the statement which is the MOST CORRECT ANSWER. Circle only one answer for each question. If you are unable to complete this questionnaire, contact your supervisor for assistance.

Column

PART A - ALL PERSONNEL

1-2 I. What is your personnel status? (01) Officer 02. Enlisted 03. Civilian

3-4 II. What is your employing organization? Circle only one. If your organization is not listed, indicate the organization with which you are most closely associated.

01.	1002nd Security Police Sq	14.	HQ 6th Wea Wg
02.	1002nd Org Maint Sq	15.	2045th Comm Gp
03.	1001st Transportation Sq	16.	Det #2, 6th Wea Wg
04.	1001st Supply Sq	17.	Det #4, 3275th Tech Sch
05.	1001st Field Maint Sq	18.	6590th Spec Act Sq
06.	1001st Civ Engr Sq	19.	OL-1, Det #5, HQ AAFS
07.	1st Comp Support Gp (Not Otherwise Listed)	20.	459th Mil Airlift Wg
		21.	Det #6000, 1030th Auditor Gen Gp
08.	1st Airborne Comd & Cont Sq	22.	OL-11K, 1800rd Support Sq
09.	1st Comp Wg (Not Otherwise Listed)	23.	HQ, Marine Flt Section
		24.	Naval Air Facility
10.	M.C. USAF Hosp	25.	MARTU
11.	1100th Support Gp (OL)	26.	FAA
12.	10th Aero Staging Flt	27.	89th Mil Airlift Wg
13.	1099th Phy Tng Flt	(28)	HQ AFSC

5-6 III. Where do you WORK? (See map on reverse side.) Circle below the zone in which you work.

01.	Zone 1	05.	Zone 5	(09)	Zone 9
02.	Zone 2	06.	Zone 6	10.	Zone 10
03.	Zone 3	07.	Zone 7	11.	Zone 11
04.	Zone 4	08.	Zone 8		

Indicate the building number at which you primarily work 1535

7-8 IV. Where do you LIVE? If you live on Base see map on reverse side. Circle below the zone in which you live.

01.	Zone 1	05.	Zone 5	09.	Zone 9
02.	Zone 2	06.	Zone 6	10.	Zone 10
03.	Zone 3	07.	Zone 7	11.	Zone 11
04.	Zone 4	08.	Zone 8		

If you live off Base, check the list below and circle the number corresponding to the area of your residence.

(12) Virginia
13. District of Columbia
14. North of District of Columbia & West of Baltimore Washington Parkway
15. North of MD Route 4 and East of Interstate 495
16. South of MD Route 4 and East of MD Route 5 (Southeast of Andrews AFB)
17. North of MD Route 5, West of Interstate 495 and South of Baltimore Washington Parkway
18. South and West of MD Route 5

For questions V and VI indicate your duty hours today using the 24-hour time system (e.g. start at 0700, end at 1530)

9-12 V. I start work at 0745

13-16 VI. I end work at 1800

17-18 VII. How did you get to work today? (01) Drove Car 04. Military Bus
02. Car Passenger 05. Cycle
03. Commercial Bus 06. Walked

PART B - DRIVERS ONLY

NOTE: Answer this section only if you DROVE today.

19-20 VIII. DRIVERS ONLY. What off Base approach road did you use for coming to work today? (Please read carefully)

01. None - live on Base
(02) Interstate 495 from West & Allentown Rd
03. Interstate 495 from North & Maryland Rte 4
04. Interstate 495 from North & Allentown Rd
05. Maryland Rte 4 from West & Dower House Rd
06. Maryland Rte 4 from West (Only, to North Gate)
07. Maryland Rte 4 from West & Allentown Rd
08. Maryland Rte 4 from East & Dower House Rd
09. Maryland Rte 4 from East (Only, to North Gate)
10. Maryland Rte 4 from East & Allentown Rd
11. Maryland Rte 5 from South & Old Alexander Ferry Rd
12. Maryland Rte 5 from South & Allentown Rd
13. Maryland Rte 5 from North & Allentown Rd
14. Maryland Rte 5 from North & Old Alexander Ferry Rd
15. Suitland Parkway & Suitland Rd
16. Suitland Parkway (Only, to North Gate)
17. Suitland Road (Only, to Main Gate)
18. Suitland Road & Allentown Rd
19. Allentown Road (Only)
20. Dower House Road from South
21. Auth Road (Only, to Bayonne Gate)
22. Auth Road & Allentown Road

21-22 IX. DRIVERS ONLY. What gate did you use to enter the Base on your way to work today?

01.	None - live on Base	04.	Virginia Ave Gate	07.	Main Gate
02.	North Gate	05.	Bayonne Drive		
03.	Pearl Harbor Gate	(06.)	West Gate		

23-24 X. DRIVERS ONLY. What gate do you normally use to exit the Base at the end of your working day?

01.	None - live on Base	04.	Virginia Ave Gate	(07.)	Main Gate
02.	North Gate	05.	Bayonne Drive		
03.	Pearl Harbor Gate	06.	West Gate		

25-26 XI. DRIVERS ONLY. Check the zone map again, please, and indicate the number of the zone in which you PARKED your car at the beginning of this work day.

01.	Zone 1	04.	Zone 4	07.	Zone 7	10.	Zone 10
02.	Zone 2	05.	Zone 5	08.	Zone 8	11.	Zone 11
03.	Zone 3	06.	Zone 6	(09.)	Zone 9		

27-28 XII. DRIVERS ONLY. What zone do you WORK in? This is the same zone as answered in Question III. Circle below the zone in which you work.

01.	Zone 1	04.	Zone 4	07.	Zone 7	10.	Zone 10
02.	Zone 2	05.	Zone 5	08.	Zone 8	11.	Zone 11
03.	Zone 3	06.	Zone 6	(09.)	Zone 9		

29-30 XIII. DRIVERS ONLY. How many people rode to work in your car today? (Include yourself.)

(01)	1	03.	3	05.	5	07.	7
02.	2	04.	4	06.	6	08.	8 or more

Exhibit D-1. Origin-Destination Questionniare

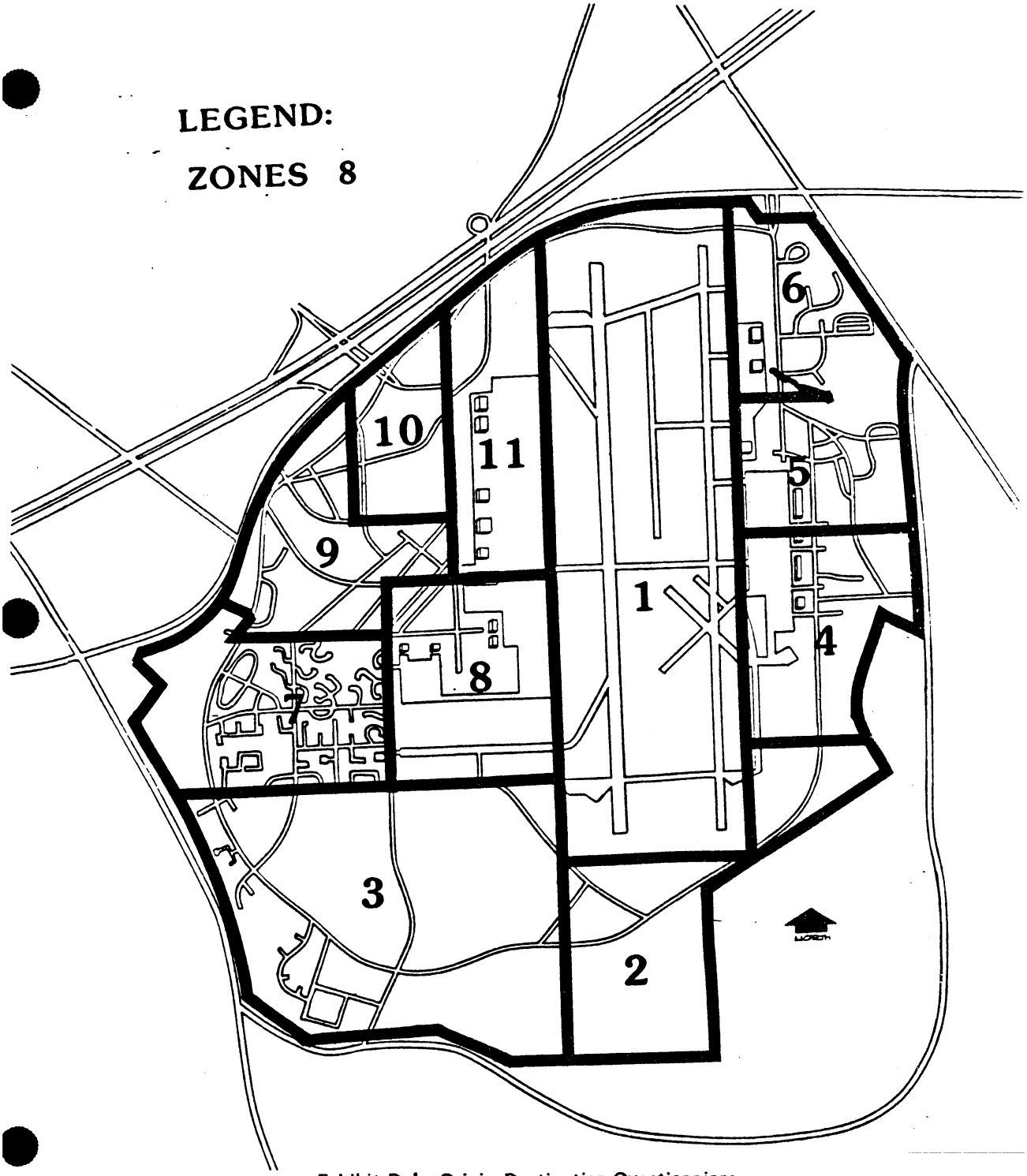


Exhibit D-1. Origin-Destination Questionniare

EXHIBIT D-2
BCP LAND USE CATEGORIES

	CATEGORY	TYPICAL FACILITIES
1.	Air Field	Runways, taxiways
2.	Aircraft Operations and Maintenance	Hangers, aircraft maintenance, base operations, control tower, fire station/ rescue, terminals, radar
3.	Industrial	Supply, vehicle operations and maintenance, base engineering, BE operations, communications, heating/ cooling, sanitation, water, fuel, small arms, training, printing, electric, storage yards
4.	Administrative	Audio visual, television, education, courts, family services, security, traffic, check house, data processing
5.	Community (Commercial)	Clothing sales, bank, CU, commissary, BX, clubs/dining halls, indoor recreation facilities
6.	Community (Service)	Schools, post office, library, chapel, other community facilities.
7.	Medical	Hospital, dental, and veterinarian facilities
8.	Housing (Accompanied)	Family housing, TLF, housing office
9.	Housing (Unaccompanied)	Unaccompanied housing (UOPH, UEPH), and visitor housing (VOQ, VAQ)
10.	Outdoor Recreation	Tennis courts, baseball fields, football fields, track, pavilions, golf, stables, pools, ranges, parks, beaches, other drill and training areas.
11.	Open Space	Conservation areas, required buffer space for safety, or security, utility easements.
12.	Water	Ponds, lakes, major streams

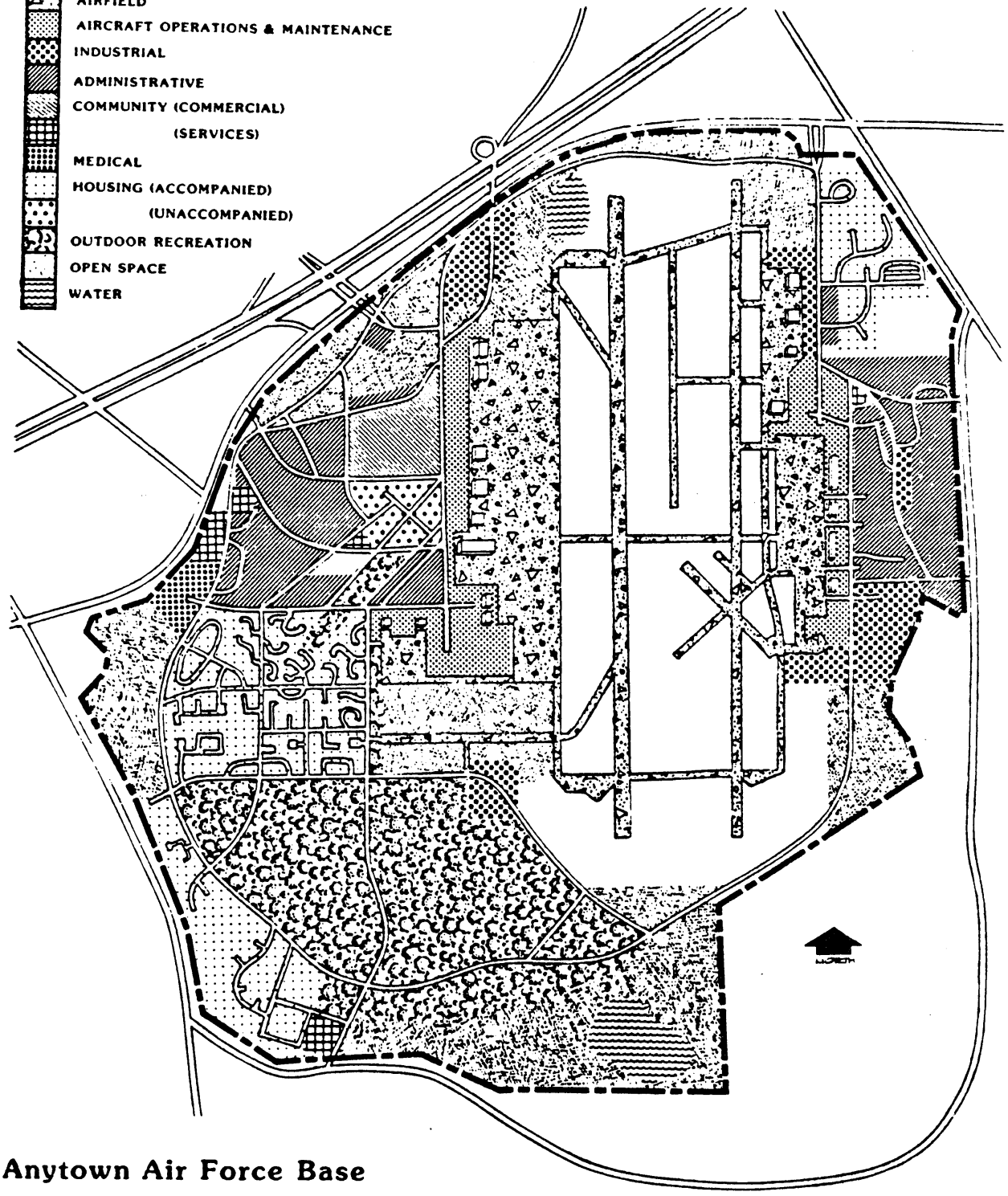


Exhibit D-2. BCP Land Use Categories

EXHIBIT D-3

AIR FORCE PARKING STANDARDS[1/]

BCP Category	Facility	Required Number of Parking Spaces
Industrial	Fire Stations	
	• 3-stall	7 spaces
	• 7-stall	10 spaces
	Maintenance Shops	38% of assigned personnel, largest shift
	Warehouses	1 space per 500 sq. ft. of office, plus 1 space per 4 persons assigned to storage activities
Administrative	Administration, HQ and Office Buildings	50% of assigned personnel
	Guardhouse, Brigs, Police Stations	30% of guard strength
	Security Offices (at gate) for installations of:	
	• 100-2,000 population	5 spaces
	• 2,001-4,000 population	10 spaces
	• 4,001-6,000 population	15 spaces
	• 6,001-10,000 population	20 spaces
	• 10,001 and up	To be based on special study
Community (Commercial)	Community Shopping Center (incl. Main Exchange, Misc. shops, Restaurant, Commissary Sales Store, Bank, Theater, Post Office	4% of authorized customers served
	Commissaries (not in Community Shopping Center)	2% of authorized customers served
	Exchanges, Main, (not in Community Shopping Center)	2% of authorized customers served
	Theaters (not in Community Community Shopping Center)	25% of seating capacity
	Cafeterias (not in Community Shopping Center)	15% of seating capacity

1/ Source: AFM 86-2 (C6)

EXHIBIT D-3
AIR FORCE PARKING STANDARDS[1/] (Cont'd)

BCP Category	Facility	Required Number of Parking Spaces
Community (Commercial)	Clubs/Dining	
	• Officers	20% of officer strength served
	• NCO's	20% of NCO strength served
	• Airmen's Dining Hall	30% of assigned military food service personnel and 38% of civilian employees
	Central Preparation Kitchen	50% of assigned military food service personnel and 38% of civilian employees
	Bakeries	38% of civilian employees (largest shift)
	Laundries and Dry-Cleaning Plants	38% of civilian employees (largest shift)
	Gymnasiums (if only one at installation)	1% of military strength
	Area Gymnasium	10 spaces
Community (Service)	Educational Dependent Schools	
	• Without Auditorium	2 spaces per classroom
	• With Auditorium	2 spaces per classroom plus 15% of auditorium seats
	Chapels	1~% of seating capacity
	Libraries	
	• Central	1 space per 500 sq. ft.
	• Branch	2 spaces

EXHIBIT D-3
AIR FORCE PARKING STANDARDS[1/] (Cont'd)

BCP Category	Facility	Required Number of Parking Spaces
Medical	Dental Clinic (separate or attached to another facility)	3 spaces per operating room
	Hospitals and Clinics	(.59 X 1 + .19 X 2) spaces [1/] where: X1 = all personnel working within the facility on a continual basis X2=average daily out-patient load for the peak month
Housing (Accompanied)	Family Housing	2 spaces per living unit
Housing (Unaccompanied)	Bachelor Officers' Quarters	90% of bedrooms
	Temporary Lodging Facilities	90% of bedrooms
	Guest Houses	90% of bedrooms
	Dormitories	1.4 spaces per room
Outdoor Recreation	Field House (combined with football and baseball facilities)	1% of military strength
	Swimming pool	20% of design capacity of pool

1/ The hospital clinic formula assumes that there is: (a) no housing for staff or patients within walking distance; (b) no public transportation system serving the facility; (c) no military shuttle system; (d) no significant number of carpools. To the extent that any of the above conditions exist, reduce the X1 and X2 values accordingly to reflect these other means of arrival at the facility.

APPENDIX E

APPENDIX E - GLOSSARY

This glossary has been prepared as an appendix to the Transportation Planning Bulletin for the United States Air Force. The acronyms and definitions included here will help the military planner who is unfamiliar with the transportation terms used in the bulletin.

The definitions which make up this glossary have their origins from the books included in the Bibliography and the following sources:

1. American Association of State Highway and Transportation Officials (AASHTO), Transportation Glossary, Washington, D.C., AASHTO, (444 North Capitol St., N.W Washington, D.C. 20001), 1983.

2. Transportation Research Board (TRB), "Glossary of Urban Public Transportation Terms," Special Report 179, Washington, D.C., TRB, (2101 Constitution Ave., N.W.., Washington, D.C., 20418), 1978.

3. Kay E. Hathaway, Librarian, JHK & Associates, 4660 Ken more Avenue, Alexandria, VA, 22304

A

AFR -- Air Force Reserves

AWS -- Alternative Work Schedule

Access -- Physical means of traveling between two points.

Accessibility -- The potential to reach certain opportunities within a given travel time.

Alternative Work Schedule -- Options that can be used by employers to change the traditional times when employees report to and leave from work. Alternative work schedule options may change one or more of the following: starting time; quitting time; number of hours in a day and number of days in a week.

Arterial -- A class of street serving a major movement of traffic not served by a freeway.

Assignment, Trip -- A process by which trips described by mode, purpose, origin, destination, and time of day are allocated among the paths or routes in a network.

Average Daily Traffic -- The average number of vehicles passing a specified point during a 24-hour period.

B

B/C -- Benefit-Cost

BCP -- Base Comprehensive Plan

Base Comprehensive Plan -- Provides a base with a full range of tools and processes for dealing with growth and change.

Base Year -- The year selected to which the major portion of the data are related. It is usually taken as the year of the survey.

Benefit-Cost Analysis -- A systematic method for determining the extent to which the benefits of a project exceed the cost.

Bikeway -- Any road, street, path, or way that is specifically designated in some manner as being open to bicycle travel, regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other vehicles or pedestrians.

Booting -- Where vehicles are immobilized by a boot clamped on a front wheel if the motorist has a certain number of outstanding parking citations.

Bus Lane -- A street or highway lane intended primarily for buses, either all day or during specified period, but used by other traffic under certain circumstances, e.g., making a right turn.

C

CIP -- Capital Improvement Program

Capacity -- 1. The maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or a roadway in one direction, or in both directions for a two-lane or a three-lane highway, during a given time period under prevailing roadway and traffic conditions. 2, The number of passengers that can be transported over a given section of a transit line in one direction during a given time period (usually l hour) under prevailing traffic conditions.

Capital Improvement Program -- A five year program of capital expenditures on base facilities, including transportation.

Carpool -- A group of people who share their automobile transportation to designated destinations on a regular basis.

Collector Street -- A street that gathers and disperses traffic between the larger arterial highways and less important streets, that has intersections at grade, and that is equally important in providing traffic movement and access to abutting properties.

Compressed Schedule -- Employees work longer days and shorter weeks. The following are most widely used: four day work week (ten hour days; three day work week (12 hour days); and 5-4/9 (9 hour days; employees work five days one week and four days the next week).

Computer Graphics -- The use of computers to prepared graphical summaries of data, such as maps, diagrams, bar charts, etc. Colors are widely used.

Cordon Line -- An imaginary line which defines a study area.

Cost-Effectiveness -- The decision-maker determined in advance some "level of effectiveness" which the chosen alternative must achieve. Alternatives are then evaluated and compared on the basis of the cost of achieving the declared level of effectiveness.

Count -- 1. A process that tallies a particular movement of people or vehicles past a given point during a state time period, giving a directional, total two-way, peak-hour, or 24-hour value. 2. A volume of persons or vehicles.

Criterion -- (See Measures of Effectiveness)

Cycle (signal) -- The time required for a traffic signal to complete all sequential phases and return to the original phase condition. (See also Phase, Traffic Signals)

D

dB -- Decibel

Data Base -- Information organized for analysis or used as the basis for a decision.

Data Collection -- The processed used to assemble information, or data, to measure existing conditions. Usually performed through field observations or surveys.

Decibel (dB) -- A unit for expressing the ratio of two amounts of electric or acoustic signal power equal to 10 times the common logarithm of this ratio.

Delay -- The amount of time by which a vehicle in service is delayed for various reasons, such as traffic congestion.

Demand -- The quantity of transportation desired.

Destination -- The point at which a trip terminates or the zone in which a trip ends.

Distribution, Trip -- The process by which movement of trips between zones is estimated. Distribution may be measured or estimated by a growth factor process or by a synthetic model.

E

Evaluation -- Methods to review specific plans. Four basic categories: pure judgment, engineering economy, willingness to pay concept, and cost-effectiveness analysis.

Express Bus -- Service that provides higher speeds and fewer stops than are generally found on other portions of the system or on the same route in local service.

Expressway -- A divided arterial highway for through traffic with full or partial control of access and generally with grade separations at major intersections.

F

Factor, growth -- A value used to adjust existing data to produce an estimate for some future year.

Flex-time -- Provides employees an opportunity to choose their work hours. The typical flex-time system uses two types of time: core-time and flex-time. Core-time is when all employees are required to be on the job. Flex-time contains preestablished limits from which employees can select their starting and quitting times.

Forecasting -- The process of determining the future values of land use, socio-economic, and trip making variables within the study area.

Forecasting Process -- A standard process which includes four elements: trip generation, trip distribution, modal split, and trip assignment.

Freeway -- A divided highway designed for the safe nonimpeded movement of large volumes of traffic, with full control of access and grade separations at intersections.

Frequency, Transit -- Frequency of service partly reflects travel convenience; the higher the service frequency, the more convenience will be provided to the public to use transit service at a randomly selected time.

Functional Classification -- The process by which streets and highways are grouped into classes, or systems, according to character of service they are intended to provide.

G

Generation, Trip -- The determination of the number of trips that have their origin or destination in a specified location or area.

Goal -- The end towards which effort is directed. The desired eventual end of a planning process.

Grade Separation -- A crossing of two highways, or a highway and a railroad, using an underpass or overpass.

Gradient -- The fall or rise per unit horizontal (or slope) length of a road, railway, etc. It can be expressed as the number of degrees from the horizontal or as a percentage.

Growth Factor -- (See Factor, Growth)

H

HOV -- High Occupancy Vehicle

Headway (Transit) -- The scheduled time gap between transit vehicles on any particular line. Headway varies with the time of day, becoming shorter at peak hours and longest at night.

High Occupancy Vehicle (HOV) -- A motor vehicle carrying a sufficient number of passengers to qualify for occupying a lane which is reserved for movement of a large number of people.

I

Implementation -- The process of moving a project from the planning stage into reality.

Intersection -- The area where two or more highways join or cross, within which are included the roadway and roadside facilities for traffic movements in that area.

Inventory -- The development of a data base for evaluating existing :travel demand and existing transportation performance, and a basis for predicting demand and future system requirements.

lteration -- The repetition of an operation or process, usually making use of the results of the previous operation.

L

LOS -- Level of Service

Land Use -- The purpose for which land or the structure on the land is being used.

Level of Service -- The quality of service provided by a facility under a given sat of operating conditions.

Link -- A section of a transportation system network defined by intersection points at each end; it may be one or two-way.

tad Point (Transit) -- The point of a transit line or run that carries the highest total number of passengers for that line or run.

Local Bus Service -- A type of operation that involves frequent stops and consequent low speeds, the purpose of which is to deliver and pick up transit passengers as close to their destinations or origins as possible.

Local Street -- A street or road primarily for access to residence, business or other abutting property.

M

MOE -- Measure of Effectiveness

MTMC -- Military Traffic Management Command

Measures of Effectiveness -- MOE's are used to determine the degree to which a particular goal or objective has been attained. MOE's are used as a basis or standard of comparison (measure), of an action which "produce a decisive, desired result" (effectiveness).

N

Network -- A system of links and nodes that describes a transportation system.

Node -- Point that represents an intersection of two or more links used in traffic assignment. (See Network)

O

O-D -- Origin - Destination Survey.

Objectives -- Operational statements of goals, measurable and attainable.

Origin -- The location of the beginning of a trip or the zone in which a trip begins.

Origin-Destination Survey -- A survey of the number, purpose, and mode of trips from various Zones of destination.

P

P&R -- Park and Ride

PH -- Peak Hour

PP -- Peak Period

Paratransit -- Forms of public transportation services that are more flexible and personalized than conventional fixed-route, fixed-schedule service but not including such exclusory services as charter bus and exclusive-ride taxi; vehicles are usually available to the public on demand, by subscription, or on a shared-ride basis.

Park and Ride -- A procedure that permits a patron to drive a private automobile to a transit station, park in the area provided for that purpose, and ride the transit system to his or her destination.

Parking Management -- Operational and regulatory actions that can affect an area's parking supply by altering the price, amount, or location of parking spaces.

Path, minimum -- The route of travel between two points that has the least accumulation of time, distance, or other impedance measure.

Peak Hour. (Peak Period) -- That hour period during which the maximum amount of travel occurs. Generally, there is a morning peak and an afternoon peak.

Phase (Traffic Signals) -- The portion of the traffic signal cycle controlling a particular movement at an intersection. (See Also Cycle Signal)

Planning -- The orderly process of preparing a detailed program for accomplishment of a predetermined goal.

Preferential Parking -- There are four types of preferential parking options: residential permit parking programs, reserved vanpool and carpool parking, reserved handicapped parking, and reserved small vehicle spaces.

Prioritization -- The process of rating and ranking projects during evaluation and prior to implementation.

Priority Lane -- A lane reserved for a particular vehicle type, such as buses, carpools, bicycles, trucks, etc.

Q

Qualitative -- Findings which are not projectable and cannot be summed up by tabulation.

Quantitative -- Values that can be tabulated and projected; relating to, or involving the measurement of quantity or amount.

Queue -- A waiting line of vehicles, (e.g., traffic at a signal)

R

ROW -- Right-of-Way

Reversible Lanes -- A highway or street lane on which, during certain hours of the day, vehicles operate in a direction opposite to that of normal flow of traffic on that lane during the remainder of the day.

Ridesharing -- A transportation service which includes carpooling, vanpooling, buspooling and transit.

Right-of-Way -- A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

Route -- The combinations of street sections connecting an origin and destination. In traffic assignment, a continuous group of links connecting an origin and destination. In traffic assignment, a continuous group of links connecting centroids that normally require the minimum time to traverse.

Rush Hour -- (See Peak Hour).

S

Sample -- A part of a statistical population that is studied to gain information about the whole.

Schedule (Transit) -- A listing in time sequences of every trip and every time point of each trip form open to close of service on a transit line.

Screen Line -- An imaginary line splitting a study area into two parts, for analysis purposes.

Shared Parking -- Sharing of a single parking facility or space by more than one land use.

Shuttle -- A public conveyance that travels back and forth over a particular route, especially a short route or one that connects two transportation systems.

Sight Distance -- The length of highway visible to the driver.

Speed and Delay Study -- Study dealing with the relationship between the travel time (speed) and the delay caused by congestion on the roadway.

Staggered Work Hours -- The starting and stopping times of groups of employees are varied to avoid having the entire work force arrive and depart at the same time. The time intervals are fixed and are determined by the employer.

Staging -- A schedule by which projects are to be implemented during the five-year capital improvement program.

Standard -- A specific characteristic of a transportation facility, for example, a pavement width, a volume capacity ratio, or a bus, service frequency. Usually set as a minimum or maximum.

Study Area -- The area delimited for the purpose of data collection by a transportation study. This area usually contains the base and surroundings and is the area for which forecasts of travel are made, in most instances.

Supply -- The quantity or quality of facilities or services provided.

Supply and Demand -- The comparison between the available supply of transportation services and facilities and the vehicular or person demand for the services and facilities.

Survey -- A data collections activity usually involving the completion of a questionnaire. Surveys may be performed in person, by telephone, or by mail, for example.

T

Timing (Traffic Signal) -- The adjustment of a traffic signal cycle and phasing to alternate the rights of way between different traffic movements. Objective usually is to minimize delay to all users of the intersection.

TSM -- Transportation System Management

Traffic Control Devices -- All signs, signals, markings and devices placed or erected for the purpose of regulating, warning, or guiding traffic.

Traffic Engineering -- Focuses on-the engineering aspects of travel on the highway system. The phase of engineering which deals with the planning, geometric design and traffic operations of roads, streets and highways, their networks, terminals abutting lands and relationship with other modes of transportation for the achievement of safe, efficient and convenient movement of persons and goods.

Transit -- Passenger transportation service, that is available to any person who pays a prescribed fare; it usually operates on established schedules along designated routes with specific stops (e.g., bus, light rail, rapid transit)

Transportation Planning -- The process used to determine appropriate means to provide for the safe and efficient movement of people and goods.

Transportation System -- A coordinated system made up of multi-modal services serving a common purpose, the movement of people and goods.

Transportation System Management (TSM) -- A part of the transportation planning process which identifies short-range, low-cost improvements for the urban transportation system. Its goal is to insure the most efficient use of the present transportation system.

Travel Forecasting -- Predicting the impacts that various policies and programs will have on travel in the urban area. (See also Forecasting)

Trip -- A one-direction movement which begins at origin and ends at destination. For example, a trip movement from a residence to a work place is a trip from home to work.

Trip Assignment -- (See Assignment, Trip)

Trip Distribution -- (See Distribution, Trip)

Trip Generation -- (See Generation, Trip)

U

UTPS -- Urban Transportation Planning System. Consists of manual and computerized planning procedures which provide decision makers with information at the desired level of detail.

V

V/C -- Volume - Capacity Ratio

Vanpool -- A pre-arranged ridesharing service in which a number of people travel together on a regular basis in a van; vanpools may be company owned, individually owned, leased and third party vanpools.

Vehicle Classification -- Volume counts that are divided into different vehicle types (e.g., passenger car, single-unit truck, combination truck, or bus). Also number of axles, weight, and dimensions can be included.

Vehicle Occupancy --The number of people in a car, truck, bus, etc.

Volume -- The number of vehicles that pass over a given section of a lane or a roadway during a period of one hour or more. Types of volume: daily traffic, annual traffic, hourly traffic.

Volume Capacity Ratio -- Used in figuring the level of service of a roadway. The number of vehicles versus the capacity of the road.

Z

Zone -- Geographically, the smallest analysis area for transportation analysis. A division of a study area that is represented by a centroid and used for traffic assignment purposes.

APPENDIX F - REFERENCES AND BIBLIOGRAPHY

This bibliography has been prepared as an appendix to the Transportation Planning Bulletin for the United States Air Force. The material included in this report has been selected from a search of literature obtained in conjunction with the preparation of this bulletin.

The following list includes documents which would provide the Air Force planner with information on various subjects that need more clarification than are provided by the explanations in the bulletin.

The annotations which make up this bibliography have their origins in the following sources:

1. Abstracts written by the author(s), editor(s), publisher(s) and/or compiler(s) of the individual documents.
2. Kay E. Hathaway, JHK & Associates Librarian, compiled frown the original documents. JHK & Associates 4660 Ken more Avenue Alexandria, VA 22304

RELATED MILITARY REFERENCES

BCP BULLETINS

1. Land Use Plans
2. Energy Planning
3. Facility Development Plan
4. Socio-cultural Environment

MTMC PAMPHLETS

5. No. 55-8 - Traffic Engineering Study Reference
6. No. 55-9 - Do's and Don'ts for Transportation Master Planning
7. No. 55-10 - Traffic Engineering for Better Roads
8. No. 55-11 - Development and Maintenance of Traffic Control Device Inventories for DOD Installations
9. No. 55-14 - Traffic Engineering for Better Signs and Markings
10. No. 55.15 - Traffic Engineering for Better Gates
11. No. 55-16 - Management Solutions for Traffic and Energy Reduction (MASTER)
    - Vol. I - MASTERing Alternative Work schedules
    - Vol. II - MASTERing Ridesharing
    - Vol. III - MASTERing Traffic Engineering

AIR FORCE REGULATIONS

12. AFR 71-4 - Hazardous Materials
13. AFR 75-88 - Highways for National Defense
14. AFR 86-2 - Standard Facility Requirements
15. AFR 86-4 - Base Comprehensive Planning (BCP)
16. AFR 127.7 - Highway Traffic Safety Program

AIR FORCE MANUALS

17. AFM 86-2 - Standard Facility Requirements (Chapter 21 - Roads and Streets)
18. AFM 86-6 - Air Base Master Planning Manual
19. AFM 86-9 - Statements of Work for Master Planning
20. AFM 88-43 - Installation Design
21. AFP 88-40 - Sign Standards
22. Air Force Energy Plan, Air Force Energy Office (HQ USAF/LEYSF), 1983

ANNOTATED BIBLIOGRAPHY

This annotated bibliography provides a selected listing of basic references on transportation planning. Each reference should be available form the source cited. Several documents are available on a fee basis from the following sources:

- NTIS U.S. Department of Commerce
  National Technical Information Service (NTIS)
  5285 Port Royal Rd.
  Springfield, VA 22161
- ITE Institute of Transportation
  Engineers (ITE)
  525 School St., S.W.
  Washington, D.C. 20024
- U.S, G.P.O. U.S. Government Printing Office
  (U.S, G.P.O.) Superintendent
  of Documents
  Washington, D.C. 20402
- TRB Transportation Research Board (TRB)
  2101 Constitution Ave., N.W.
  Washington, D.C. 20418

23. Abrams, Charles M. and John F. DiRenzo, Measures of Effectiveness for Multimodal Urban Traffic Management, Vol. I, Measure of Effectiveness for TSM Strategies, and Vol. 2, Development & Evaluation of TSM Strategies, Alexandria, VA, JHK & Associates, December 1979-December 1981, 2 vols. (Available: NTIS)
A three-phase study that developed measures of effectiveness (MOE's) for Transportation Systems Management (TSM) strategies. Phase I: Explains TSM Strategies and tactics and comprehensive goals and objectives that were developed. Phase II: Tells of four case studies that were conducted. Phase III: Sampling and data collection procedures that were developed.
24. American Association of State Highway and Transportation Officials (AASHTO), A Manual on User Benefit Analysis of Highway and Bus-Transit Improvement AASHTO, 444 N. Capitol St., N.W., Wash., D.C. 20001, 1977, 189 p. (Available: AASHTO).
Provides cost factors, nomographs, and guidelines for estimating the economic effects of highway and bus-transit improvements on highway and transit users. Presents all of the information needed for economic analysis of most types of highway and bus-transit improvements.
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Provides a contemporary assessment of the experience and insights gained from the application and analysis of various transportation system changes. Explains how travel demand can be affected by different types of transportation actions.
26. Box, Paul C. and Joseph C. Oppenlander, Manual of Traffic Engineering Studies, 4th ed., Reston, VA, Reston Publishing Company, Inc., 1976, 258 p. (Available: ITE)
Presents techniques and practices of transportation studies including inventories for traffic, traffic volumes, traffic accident, travel times and delays, origin-destination, parking, public transportation usage, and street lighting studies.
27. Carter, Everett C. and Wolfgang S. Homburger, Introduction to Transportation Engineering, Institute of Transportation Engineers, Wash., D.C., 1978, 259 p., (Available: ITE).
Basic textbook which gives a comprehensive overview of planning, designing, and operating transportation facilities. Topics include vehicular and human characteristics, traffic measurements, mass transit, urban transportation planning, and management/administration.
28. Dickey, John W., Sr. Author, et al., Metropolitan Transportation Planning, 2nd ed., New York, McGraw-Hill Book Company, 1983, 607 p. (Available: McGraw-Hill).
A textbook used in introductory courses in transportation planning. Explains the "transportation planning process" in ten stages. Presents a state of the art in metropolitan transportation planning.

29. DiRenzo, John F., Bert Cima, and Edward Barber, Stud of Parking Management Tactics Wash., D.C., Peat, Marwick, Mitchell & Company, vols., 7 , Available: NTIS).
Six types of parking management tactics are focused on in Volumes l and 2 of this report: On-street parking supply tactics; off-street parking supply tactics for activity centers; fringe and corridor parking facilities; pricing tactics; enforcement and adjudication tactics; and marketing tactics. Documents and assesses characteristics based upon applications in selected cities across the U.S. Volume 3 is a parking management guide to assist in planning, implementing, and operating parking management tactics.
30. Fruin, John J., Pedestrian Planning and Design, Association of Urban Designers and Environmental Planners, Inc., P.O. Box 72 , Church Street Station, New York, NY 10008, 1971 (Available: Association Above).
A primarily quantitative study of pedestrian movement characteristics. Topics include physiological and psychological factors affecting planning of pedestrians spaces, traffic and space requirements. Includes discussion of the current developments in improving the pedestrian environment.
31. Highway Research Board (HRB), "Highway Capacity Manual, 1965," Special Report 87, Transportation Research Board, Wash., D.C. 1965, 397 p. (Available: TRB).
A guidebook to be used in determining the capacity, service volume, or level of service which will be provided by either a new highway design or an existing highway, under specified conditions. When given a certain traffic demand, the design necessary to accommodate that demand at a given level of service can be determined. Includes sections on freeways, intersections, pedestrians, and bus transit.
32. Homburger, Wolfgang S., ed., Louis E. Keefer and William R. McGrath, assoc. eds., Transportation and Traffic Engineering Handbook, 2nd edition, Englewood Cliffs**,** N3, Prentice-Hall, Inc., 19g2, £96 p. (Available: ITE).
An authoritative reference to assist transportation and traffic professionals in the state of the science o~ the planning, design, and operations of surface transportation facilities. Twenty-eight chapters on different subjects including: transportation and society; highway transportation; urban transit; human factors in transportation, urban travel characteristics; statewide and regional transportation planning, urban transportation planning, circulation in major activity centers; traffic signs and markings; traffic signals; traffic regulation; and transportation administration.
33. Institute of Transportation Engineers (ITE), Trip Generation, 3rd ed., Wash., D.C. ITE l 983, vp. (Available: ITE).
Provides traffic and transportation engineers with a single document and guide on trip generation rates for many land uses and building types.

34. JHK & Associates, Planning Guide for Development of Pedestrian and Bicycle Facilities (State of Wisconsin), Alexandria, VA, August, 1977, vp. (Available: State of Wisconsin, Governor's Office of Highway Safety).
A manual to assist local communities to plan, design, and implement pedestrian and bicycle facilities. This manual provides: a step-by-step planning procedure to aid in identifying needs, wants, and objectives; an explanation of the types of facilities that may be developed and the pros and cons of each; information on the "state of the art" design elements for pedestrians and bicycle facilities; information on approximate costs and funding sources; and technical assistance and other resources.
35. Kagan, L.S., W.G. Scott, and U.P. Avin, A Pedestrian Planning Manual, Baltimore, MD, RTKL Associates, Inc., November 1978, 2 vols. (Available: NTIS).
A manual that identifies the significant data, procedures and criteria that should be considered in the planning and evaluation of both comprehensive pedestrian systems and individual pedestrian facilities.
36. Marks, Harold, Traffic Circulation Planning for Communities, Los Angeles, CA, Gruen Associates, April 1974, 296 p. (Available: Motor Vehicle Manufacturers Association, Inc.)
The objective of this study was to compile a methodology for traffic circulation planning, including principles and techniques that can be used by administrators and officials, engineers, and planners. The study provides practical recommendations based on the fundamental concept that circulation systems must be developed within the context of the total urban environment. The planning guidelines are developed from basic community-design concepts; they show how a simultaneous approach to community planning and circulation planning may proceed.
37. Mayer, Richard W., Bicycle Planning and Design, American Society of Landscape Architects, 1733 Connecticut Ave., N.W., Wash., D.C., 1978 (Available: ASLA above).
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38. Peat, Marwick, Mitchell & Co. (PMM), Simplified Aids for Transportation Analysis, Wash., D.C., PMM, January 1979, 6 vols., (Available: NTIS).
A series of six reports describing simplified aids to improve transportation decisions without resorting to computers or extensive data collection. The following titles are available: Annotated Bibliography; Forecasting Auto Availability and Travel; Estimating Ridership and Cost; Transit Route Evaluation; Estimating Parking Accumulation; and Fringe Parking Site Requirements.

39. Pedersen Neil J., and Donald R. Samdahl, "Highway Traffic data for Urbanized Area Project Planning and Design," NCHRP Report 255 Wash., D.C., TRB, Dec. 1982, 191 p.(Available: TRW
This report provides a comprehensive compilation of the best techniques that are currently being used to develop highway traffic data for use in project planning and design in urban areas. These techniques were identified through a survey of state and local agencies with follow-up field visits to obtain detailed information on procedural steps and typical applications. A user's manual with illustrative case studies is provided in the Appendix.
40. Public Technology, Inc. (PTl), The Urban Transportation Planning System (UTPS): An Introduction to Management, PTl, 1301 Pennsylvania Ave., N.W., Wash., D.C. 20006, June 1980, 33 p. (Available: PTI).
UTPS provides planning and impact forecasting tools to meet the decision making - needs of local planning staffs. UTPS manual and computer methods can help to answer questions as: Will present roads accommodate future travel demands?, How will traffic circulation be affected by proposed land uses?, What road improvements should live highest priority?, What ridership should be expected on a proposed bus route? Maps, graphs, and tables generated by UTPS help local officials compare alternative solutions.
41. Reilly, William R., James H. Kell, and Iris 3. Fullerton, Design of Urban Streets, San Francisco, CA, JHK & Associates, January 1980, vp. (Available: U.S. G.P.O.)
Training course developed for the Urban Traffic Operations Training Program. Includes a review of urban street planning concepts; design factors, including specific material on current practice; roadway cross-sections, alignment, and location; and, details on design and operation of intersections.
42. Smith, Daniel T., et al., State of the Art: Residential Traffic Management, San Francisco, CA, DeLeuw, Cather & Company, December 1980, 181 p. (Available: NTIS).
Presents practices in residential traffic management. Assesses the performance of various control devices that affect traffic on existing residential streets. Details techniques for developing neighborhood traffic control plans including community involvement and technical evaluation elements.
43. Sosslau, Arthur B., et al., Transportation Planning for Your Community (series of two guides and five technical manuals), Wheaton, MD., COMSIS Corp. 1980 (Available: U.~ G.P.O.)
Series is designed to acquaint officials and planners with transportation planning for communities from 25,090 to 200,000 population. Guides explain the concepts of transportation planning. Manuals describe techniques for carrying out transportation planning programs.

44. Sosslau, Arthur B., "Quick-Response Urban Travel Estimation Techniques and Transferable Parameters, User's Guide," NCHRP 187 Transportation Research Board, Wash., D.C. 1978, 220 p. (Available: TRB).
This report provides detailed descriptions of manual techniques for use in each aspect of travel demand estimation. Numerous charts, table, and nomographs are included to simplify each analysis step.
45. Stopher, Peter R. and Arnim H. Meyburg, Urban Transportation Modeling and Planning, Lexington, MA, Lexington Books, D.C. Health & Company, April 1977, 345 p. (Available: Publisher).
Advanced textbook which examines the available techniques and current research in travel-forecasting procedures. Outlines the evolution of the transportation-planning process and the steps involved in this procedure. This book concentrates upon the development of the theories, concepts, and structure of travel-forecasting models and methods, and of current research concerned with developing new methods.
46. Transportation Research Board (TRB), "Interim Materials on Highway Capacity," TRB Circular 212, TRB, N.W., Wash., D.C. 1980, 276 p. (Available: TRB).
Includes up-to-date information and improved procedures in selected areas of highway capacity analysis. Subjects included in the Circular are: critical movement analysis, unsignalized intersections, weaving analysis; and freeway analysis procedures. This Circular supplements the Highway Capacity Manual, 1965.
47. U.S. Department of Transportation, Manual on Uniform Traffic Control Devices for Streets and Highways, (MUTCD) Wash., D.C., U.S. DOT, FHWA, 1978. (Available: U.~ G.P.O.)
Sets forth the basic principles that govern the design and usage of traffic control devices. resents traffic control device standards for all streets and highways. Five basic aspects are considered: design, placement, operation, maintenance, and uniformity. A companion document, the Traffic Control Devices Handbook (1983), provides information related to the fundamental concepts of traffic regulation and control, traffic control devices, current application practices, and promising traffic engineering techniques of the future.

48. Alan M. Voorhees & Associates, Inc., Handbook for Transportation System Management Planning; An Analytical Approach to the Development and Evaluation of Transit-Related TSM Projects and Alternatives, Bedford, TX, North Central Texas Council of Governments. (NCTCOG), March 1978, 3 vols. (Available: NCTCOG)

Gives the technical approach to TSM Planning in three volumes. Volume l discusses the TSM planning process with emphasis on the more complex, area-wide TSM actions. Volume 2 provides a set-of manual analytical procedures aimed more toward individual TSM actions. Volume 3 presents information on automated techniques that would be called for when evaluating complex multimodal action combinations.

49. Yu, Jason C., Transportation Engineering, Introduction to Planning, Design, and Operations, Elsevier, 32 Vanderbilt Ave., NY 16017,1982, 462 p. (Available: Elsevier).

Basic text for introductory courses in transportation engineering. Part I deals with multimodal transportation systems planning. A thorough discussion on area-wide `planning with consideration of modal interactions provides an essential foundation for the study of the individual modal facilities. Parts II through VII discuss individual major transportation systems: highway, urban mass transit, air, rail, water, and pipeline. Each part consists of modal-specific planning, design, and operation principles and their applications.

Department of Defense
INSTRUCTION

November 15, 1985
NUMBER 6055.4

SUBJECT: Department of Defense Traffic Safety Program

References:
(a) DoD Instruction 6055.4, "Department of Defense Traffic Safety Program," November 7, 1978 (hereby canceled)
(b) DoD Directive 1000.3, "Safety and Occupational Health Policy for the Department of Defense," March 29, 1979
(c) Highway Safety Program Standards-Applicability to Federally Administered Areas, July 13, 1973 (Title 23, Code of Federal Regulations, Section 1230)
(d) Uniform Standards for State Highway Safety Programs, August 15, 1973 (Title 23, Code of Federal Regulations, Section 1204)
(e) through (n), see enclosure 1

A. REISSUANCE AND PURPOSE

This Instruction:

1. Reissues reference (a).
2. Provides guidance in administering a comprehensive DoD traffic safety program under the requirements of reference (b), in order to reduce deaths, injuries, and property damage caused by traffic accidents.
3. Carries out, where relevant, the provisions of references (c), (d), and Pub. L. 89-564 (reference (e)) within the Department of Defense.

B. APPLICABILITY

This Instruction applies to the Office of the Secretary of Defense (OSD), the Military Departments (including the National Guard and Reserve Components), the Organization of the Joint Chiefs of Staff (OJCS), the Unified and Specified Commands, and the Defense Agencies (hereafter referred to collectively as " DoD Components"). For the purpose of this Instruction, the Army-Air Force Exchange Service (AAFES) is considered a DoD Component.

C. POLICY

It is DoD policy that an effective, comprehensive traffic safety program be established and maintained as an element of the overall DoD mishap prevention program prescribed in DoD Directive 1000.3 (reference (b)). Such programs shall conform to the requirements set forth herein.

D. RESPONSIBILITIES

1. The Assistant Secretary of Defense (Force Management and Personnel (ASD(FM&P)), as the designated DoD safety and occupational health official, shall:

a. Represent the Secretary of Defense in matters concerning the Department of Defense and the Department of Transportation (DoT) regarding National traffic safety policy issues which involve the Department of Defense.

b. Solicit and consolidate comments on existing, revised, or proposed DoT regulations, as appropriate, to provide a single DoD position for submission.

c. Provide programming criteria, guidance, and instructions for the incorporation of t raffic safety program elements in appropriate DoD programming and budget documents.

d. Coordinate proposed traffic safety policy and guidance with other appropriate offices within the OSD.

e. Conduct periodic evaluations of DoD Component traffic safety programs.

2. Heads of DoD Components shall establish programs under the cognizance of the DoD Components' designated safety and occupational health officials to carry out the provisions of this Instruction. Such programs will include the minimum requirements set forth below.

E. PROCEDURES

1. Highway Safety Program Standards. The provisions of the DoT Highway Safety Program Standards (reference (c)), in part, require the Department of Defense to carry out such standards as they are relevant to the activities of the Department of Defense. DoD implementation of the Highway Safety Program Standards (reference (c)), modified as necessary in consideration of unique military requirements and the Department of Defense's worldwide operations, is contained in enclosure 2.

2. Safety Standards for DoD Motor Vehicles.

a. Commercial vehicles as defined in Appendix A of DoD 4500.36-R (reference (f)), which are purchased, leased, or rented by the Department of Defense shall meet all applicable requirements of the Federal Motor Vehicle Safety Standards (reference (g)). Commercial vehicles of foreign manufacture purchased for use outside the United States and its territories and possessions shall meet all applicable safety requirements of the country in which they are to be used.

b. Tactical and combat vehicles, designed to contract specifications, are exempt from the provisions of the Federal Motor Vehicle Safety Standards (reference (g)). Such specifications shall, however, comply with the intent of those standards, provided compliance does not degrade essential military characteristics. With the same limitation, compliance with applicable provisions of Federal Motor

Carrier Safety Regulation is a DoD requirement. Military Standard 1180 (AT) (reference (h)), provides guidance to ensure that proper safety characteristics are designed into tactical and combat vehicles consistent with the following constraints, listed in order of priority.

(1) Military mission requirements.

(2) Federal Motor Vehicle Safety Standards (reference (g)) and Federal Motor Carrier Safety Regulations.

(3) Requirements of friendly nations within whose borders U.S. vehicles are operated by DoD personnel.

3. Occupant Crash Protection. The use of occupant restraint devices (safety belts, air bags, child restraints, etc.) dramatically reduces the number of deaths, and the number and severity of injuries experienced in motor vehicle crashes. Accordingly, the following special requirements for occupant crash protection shall be included in DoD Component traffic safety programs:

a. All commercial-type passenger-carrying vehicles that are purchased, leased, or rented by the Department of Defense, shall be equipped with the occupant restraints required by Federal Motor Vehicle Safety Standards (reference (g)). DoD special purpose, tactical and combat vehicles, whether purchased commercially or designed to contract specifications, shall also be equipped with safety belts and rollover protection when appropriate, unless the Head of the DoD Component acquisition activity determines that such equipment will unacceptably degrade as essential military characteristic.

b. Occupant restraints will be maintained in a serviceable condition and will be readily available for driver and passenger use.

c. All personnel operating or riding as a passenger in a DoD motor vehicle shall wear safety belts when sitting in those seats in which safety belts have been installed by the vehicle manufacturer, whether on or off a DoD installation. Individuals shall not ride in seats from which manufacturer installed occupant restraints have been removed or rendered inoperative. The vehicle operator is responsible for informing passengers of the safety belt requirement. The senior occupant is responsible for ensuring enforcement. With respect to civilian employees, when it is not clear who is the senior occupant, the driver is responsible for ensuring enforcement.

d. To the extent possible, personnel will be transported in passenger vehicles such as sedans, station wagons, or buses. The number of passengers transported in these vehicles will be restricted to the designated seating capacity. When mission requirements exceed the availability of such vehicles, cargo vehicles may be used under the provisions of (1) and (2) below:

(1) There must be adequate fixed seating. Occupants will be seated when the vehicle is in motion.

EXCEPTION: Personnel may be transported without fixed seats for short distances on the installation provided each passenger remains seated wholly within the body of the vehicle and the body is equipped with stakes or sideboards.

(2) Whenever a dump truck is used to transport personnel, positive locking devices will be used to prevent accidental activation of hoist controls.

e. Nonuse or malfunction of DoD motor vehicle occupant restraints that result in injury to DoD personnel shall be reported and remedial action will be taken to prevent recurrence, under the DoD mishap reporting system established by DoD Instruction 6055.7 (reference (l)).

f. All persons (DoD military and civilian personnel, DoD dependents, contractor personnel, nonappropriated fund employees, visitors to installation, etc.) operating or riding as a passenger in a privately owned or rented motor vehicle (POV) on a DoD installation shall wear safety belts when sitting in those seats in which safety belts have been installed by the vehicle manufacturer. Individuals shall not ride in seats from which manufacturer installed occupant restraints have been removed or rendered inoperative. Safety belts will also be used when the POV is being used for official DoD business off a DoD installation. DoD Components shall develop educational programs to encourage the use the safety belts during private motor vehicle operations.

g. All DoD installations shall comply with and enforce applicable State mandatory safety belt and child restraint laws. DoD installations are encouraged to establish child safety seat loaner programs.

h. Each DoD Component that regulates driving privileges, shall establish procedures for appropriate mandatory administrative or disciplinary action to include the suspension of driving privileges on military installations, and in areas subject to military traffic supervision for noncompliance with paragraphs E.3.c. and f. above. Traffic points shall be assessed in accordance with Joint Service Regulation AR 190-5 (reference (j)). All levels of supervision and management shall actively participate in the enforcement of this program and become involved by personal example and precept.

4. Speed Limits. Programs shall stress strict compliance with the National maximum 55 mph speed limit, except during bonafide military emergencies. Additionally, speed limits (maximum/minimum) established for DoD installations shall be based on traffic engineering requirements, and be consistent with State and local laws.

5. Operator Duty Time. To reduce the potential for traffic mishaps caused by operator fatigue, specific peacetime duty hour limits for DoD vehicle operators shall be prescribed and enforced. These duty hour limits should consider the degree of risk involved in various DoD motor vehicle operations, e.g., weapon convoys, flight line and public highway operations.

6. Use of Headphones or Earphones. The wearing of portable headphones, earphones, or other listening devices while operating a motor vehicle and while jogging, walking, bicycling, or skating on roads and streets on DoD installations is prohibited. Use of these devices masks or prevents recognition of emergency signals, alarms, announcements, the approach of vehicles, human speech, and the ability to determine the direction from which sound is coming.

F. EFFECTIVE DATE AND IMPLEMENTATION

This Instruction is effective immediately. Forward two copies of implementing instructions to the Assistant Secretary of Defense (Force Management and Personnel) (ASD(FM&P)) within 120 days.

Acting Assistant Secretary of
Defense (Force Management and
Personnel)

Enclosures - 2

1. References
2. Highway Safety Program Standards Requirements

D. Driver Licensing (HSPS No. 5). Minimum DoD licensing procedures are set forth in DoD 4500.36-R (reference (f)).

E. Codes and Laws (HSPS No. 6)

1. All DoD installation traffic codes shall assimilate, to the maximum extent practical, the traffic codes of the State or Nation in which the installation is located.

2. The Uniform Vehicle Code and Model Traffic Ordinance (reference (k)) shall be used in the design of DoD installation traffic codes.

F. Traffic Courts (HSPS No. 7)

1. All traffic violations occurring on DoD installations (within the United States or its territories) may be refereed to the appropriate United States Magistrate, or State of local system magistrate, in the interest of impartial judicial determination and effective law enforcement.

2. When the State or host Nation operator's license has been suspended or revoked by a court of law, the involved DoD member shall not be permitted to operate a DoD vehicle during the suspension period.

G. Mishap Investigation, Reporting and Analysis (HSPS Nos. 9, 10 and 18)

1. All accidents which involve DoD vehicles will be investigated and reported in accordance with the requirements of DoD Instruction 6055.7 (reference (l)).

2. In addition, each DoD installation shall establish a program to ensure the analysis of local DoD traffic accidents and the application for corrective measures to reduce frequency and severity. This program shall include all on-base and off-base road networks in proximity to DoD installation, e.g., access roads and routes heavily traveled by DoD vehicles. The program as a minimum shall provide for:

a. Accurate identification of accident locations and an analysis of high incidence locations. The analysis should include identification of those design and operating features which contribute to the high accident frequency or severity.

b. Abatement of on-base traffic hazards in accordance with the provisions of paragraph 5 (Enclosure 2) of DoD Instruction 6055.1 (reference (l)).

c. Close coordination between DoD Component and local officials to resolve off-base traffic problems of mutual concern.

H. Highway Design, Construction and Maintenance (HSPS No. 12). DoD installation road networks shall be maintained in a safe condition, and capital improvements to modernize existing roads or to provide new traffic facilities shall meet the safety standards issued or endorsed by the Federal Highway

Administration, DoT. Compliance will be evaluated periodically by the Commander, Military Traffic Management Command (MTMC), in accordance with the responsibilities assigned to that command in section I, below.

I. Traffic Engineering Services (HSPS No. 13). In accordance with the provisions of DoD Directives 5160.53 and 5160.60 (references (m) and (n)), the MTMC, under the direction of the Army shall coordinate and ensure DoD implementation of Highway Safety Program No. 13, Traffic Engineering Services, and coordinate with the Federal Highway Administration and other Governmental and non-Governmental agencies, as required or appropriate.

J. Pedestrian Safety (HSPS No. 14). Pedestrian safety shall receive emphasis throughout the Department of Defense as a part of the overall traffic safety program. Separation of pedestrian and motor vehicle traffic, and provision of adequate sidewalks, pedestrian crossings, and bicycle paths to ensure maximum safe traffic flow without jeopardizing pedestrian safety shall be included. Pedestrian-motor vehicle mishaps shall be analyzed and reported per section G. above. Particular emphasis shall be placed on the protection of children walking to and from school, entering and leaving school buses, and playing in DoD housing areas. Appropriate fluorescent or reflective personal protective equipment will be provided to and used by all DoD personnel who are exposed to traffic hazards as a part of their assigned duties, e.g., marching troops, traffic control personnel, road construction crews, electricians or telephone repair personnel working on outside overhead lines.

K. Pupil Transportation Safety (HSPS No. 17). Provisions shall be made to reduce, to the greatest extent possible, the danger of death or injury to children while they are being transported to and from school, or related activities, in DoD or contractor owned vehicles. To this end, DoD school buses shall be marked, equipped, operated, and maintained in a manner consistent with HSPS No. 17. Private contractors shall comply with State and local requirements in addition to any requirements set forth by the involved DoD Component.